SCIENTIFIC AMERICAN

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THE RIGID SUSPENSION BRIDGE AT LOSCHWITZ, SAXONY.

BY ROBERT GRIMSHAW.

The earliest suspension bridges—suggested probably by the vine trailing across from one tree to another on opposite sides of a stream, was characterized by extreme lateral and vertical flexibility. As in instance after instance this was found to be a source of danger, engineers in successive suspension structures endeavored to give an element of stiffness.

One method employed by Roebling, at the Niagara wire rope bridge, was the addition of a wooden lattice girder; but this did not give sufficient stiffness to permit of the passage of railway trains at any but a slow rate of speed.

About 1856 a railway was planned between Hamburg and Harburg, crossing the River Elbe twice, with a width near Harburg of about 1,000 feet of deep water and 2,000 feet in all. At that time the erection of piers in deep and rapid rivers with sandy bottom was deemed risky and unsafe, and as the cantilever principle had not yet been introduced, the bridging of the deep portion of 1,000 feet span was planned to be effected by a suspension bridge. (It may be noted that afterward girder bridges have been constructed both at Hamburg and at Harburg, with piers only 100 meters = 328 feet apart.)

For stiffening this proposed structure it was recommended so to connect the chain with the roadway frame that each half formed a rigid beam, hung from one end on a pier and hinged at the center to its mate. As the bending influence of the live load was highest

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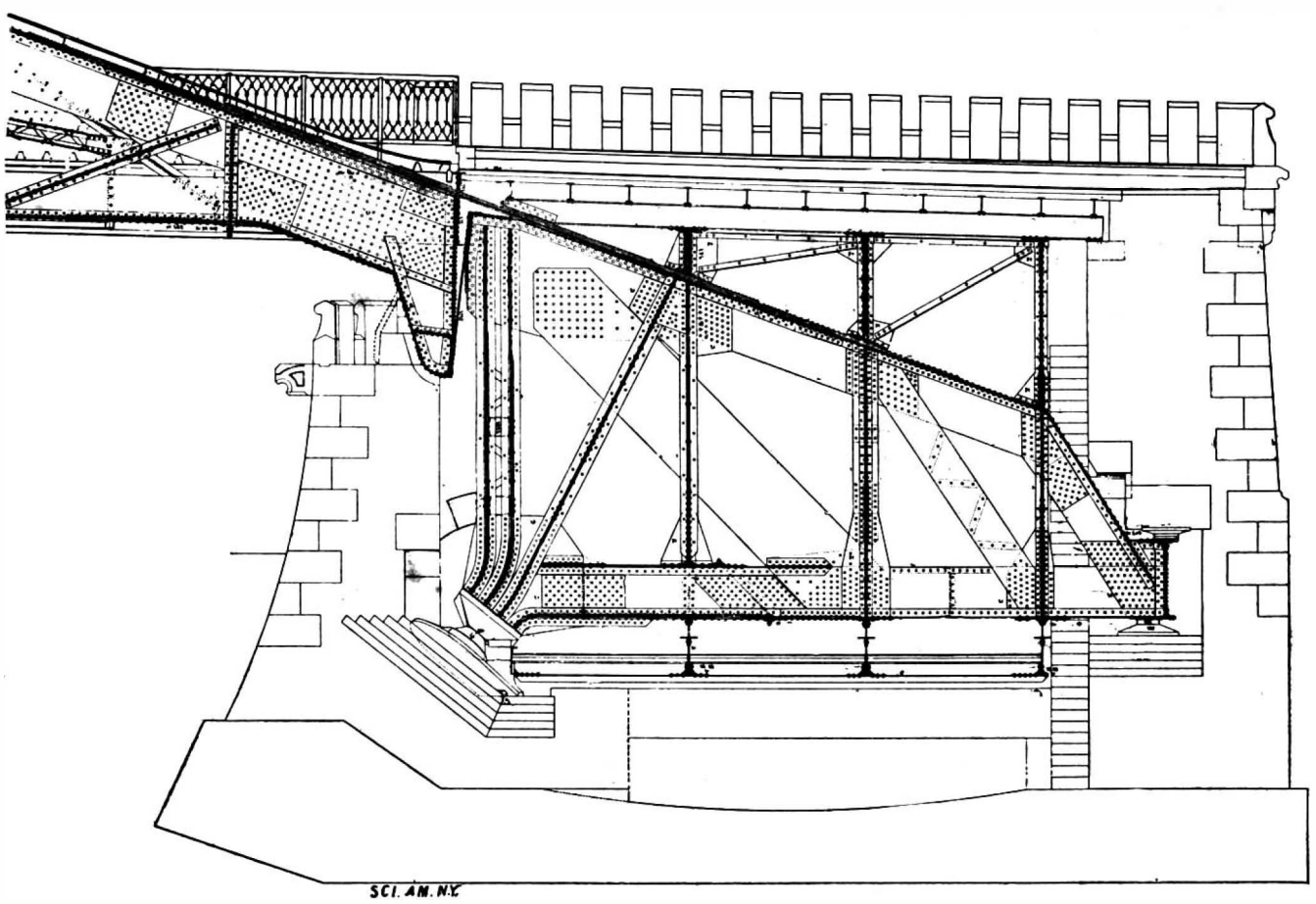

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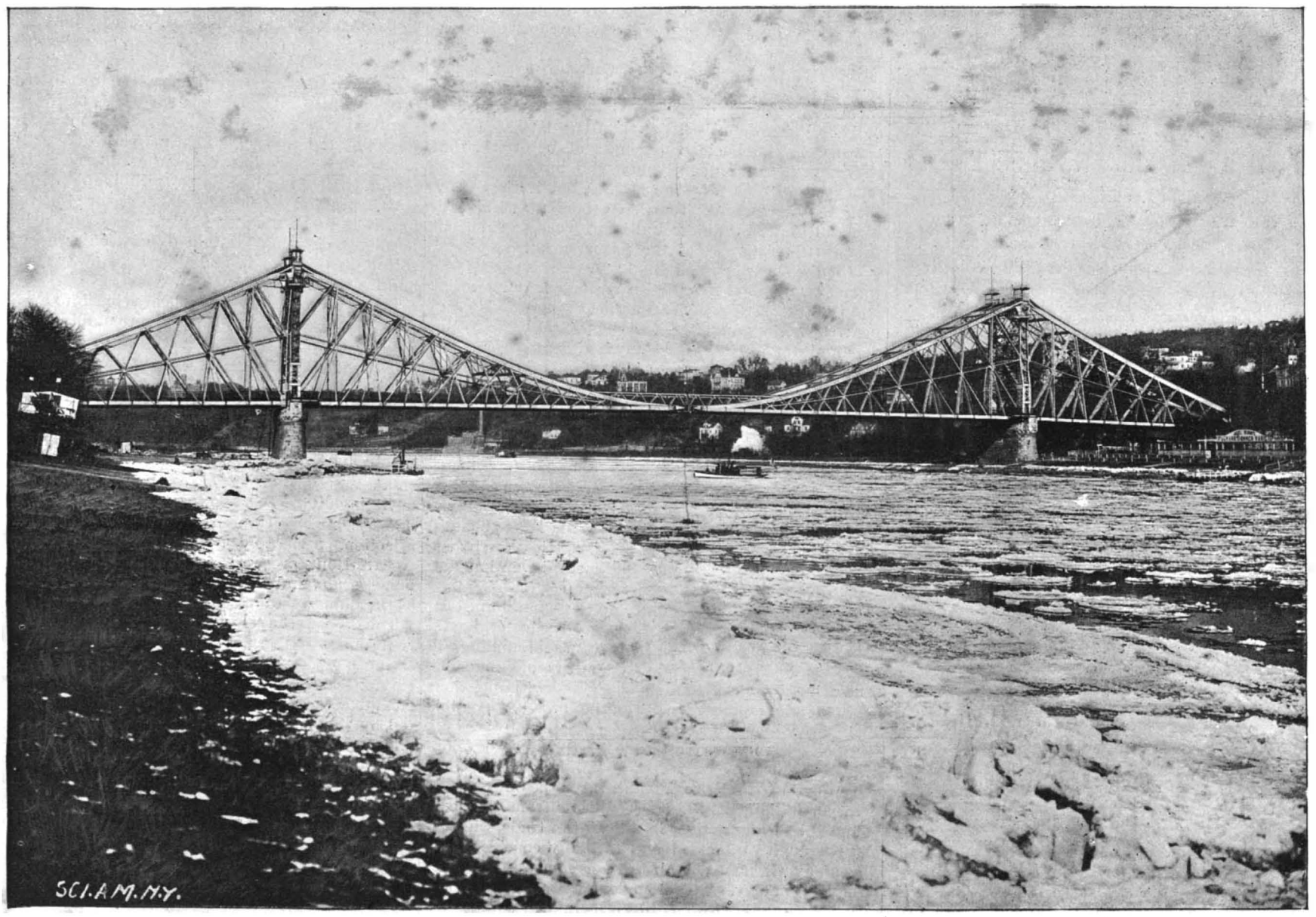

RIGID SUSPENSION BRIDGE AT LOSCHWITZ, SAXONY.

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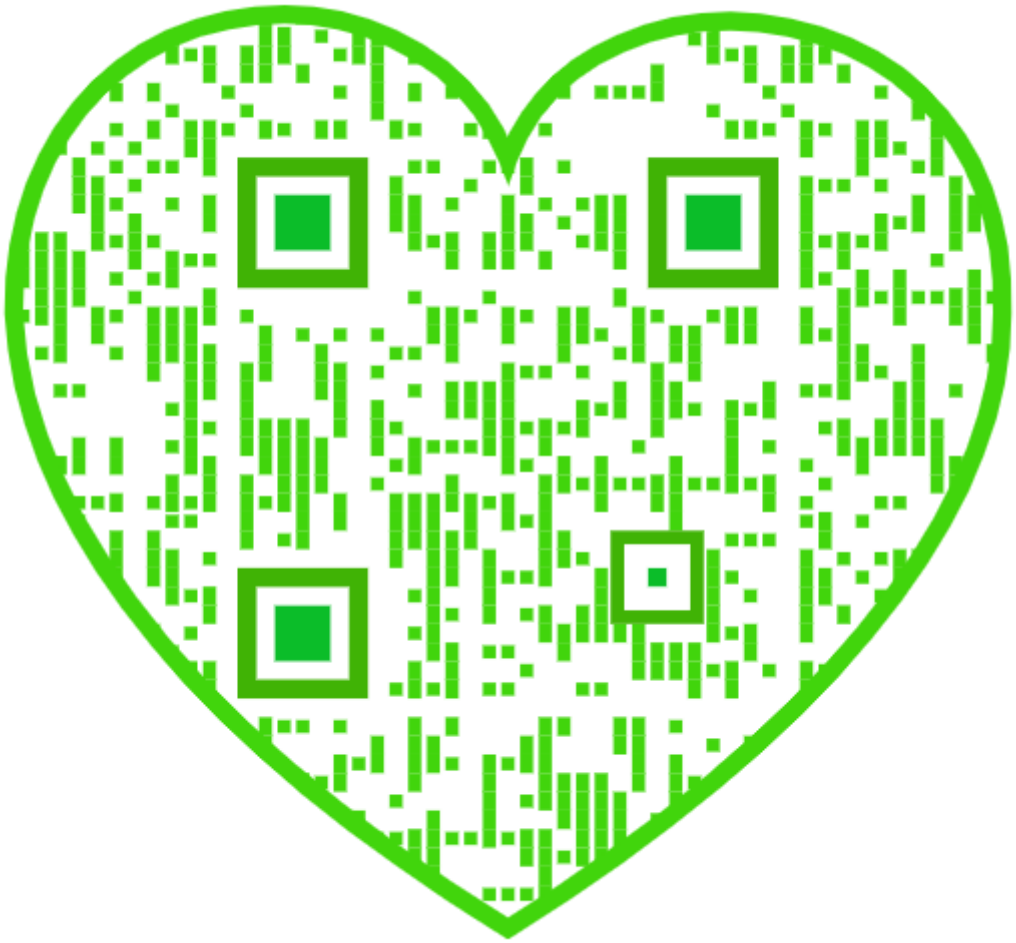

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THE SECRETS OF GERMANY'S INDUSTRIAL SUCCESS.

Perhaps the most notable fact in the industrial world just now is the commanding position which is being won by the German manufacturers and the rapid encroachments which they are making upon the foreign trade of other nations, and particularly upon that of Great Britain. In taking note of this development we must remember that it is nothing new, that it is not the result of a sudden outburst of energy. It is merely the larger development, the coming of age, of a system which has been steadily at work in Germany for many years. Her industrial triumph, which has come as a surprise to the world at large, and with a rude, awakening shock to Great Britain in particular, is no surprise to the German people themselves. In school and college, in workshop and factory, by carefully planned organizations at home and abroad, they have set in motion a system of industrial forces which are now working out the desired results with mechanical regularity and precision.

The German mind is essentially scientific and methodical. It was these qualities that contributed largely to the signal triumph of the German arms in the memorable war of 1870. During the quarter of a century that has intervened since the close of the struggle and the consolidation of the empire, Germany has been applying the same scientific methods to the arts of peace; and with such success that it begins to look as though her industrial armies were going to occupy the broad fields of international commerce with the same resistless energy with which her battalions marched from Saarbruck to Sedan a quarter of a century ago.

Germany owes her industrial success to her system of scientific training in schools and colleges, to the close fellowship which exists between her factories and her schools, and to her elaborate organizations for the control and development of commerce.

That the scientific course in German schools was thorough and effective has always been well understood; but it has been reserved for a private letter, written by Prof. Ostwald, the distinguished German chemist, to his English friend Prof. Ramsay, to open the eyes of the world, and particularly of the English people, who are most nearly affected, to the practical use to which the scientific researches of their specialists are put by the German people. It appears from this letter that there is a close alliance between the German manufacturers and the universities and high grade technical schools. In the chemical industry, for instance, it seems that splendid inducements are offered to the graduates of technical colleges to enter the laboratories which form part of the equipment of the factories. These young men are engaged, not for the executive work of the establishment, but for purely experimental work in the laboratory. They form a brigade of skilled inventors, who devote themselves to the discovery of improved processes and methods of manufacture.

Speaking of this system, Prof. Ostwald says:

"The research laboratory in such a work is only different from one in a university by its being more splendidly and sumptuously fitted than the latter. I have heard from the business managers of such works that they have not unfrequently men who have worked for four years without practical success; but if they know them to possess ability, they keep them notwithstanding, and in most cases with ultimate success sufficient to pay the expenses of the former resultless years."

When we bear in mind that "there are often more than one hundred Ph.D.'s in a single manufactory," and that this little army of qualified scientists is occupied solely in "making inventions," we begin to understand why it is that Germany is already pre-eminent in certain markets of the world, and it is likely to become so in others before long. Invention is no longer left to the unaided efforts of the well meaning, but often uninstructed, individual. In the special laboratory there will be no long hours of fruitless search for an object whose supposed existence is based upon ignorance of the first principles of physics or mechanics. In this admirable combination of the skilled theorist and the trained mechanic there is little left to chance; and the development of an art is carried on by the sure and logical process of experiment, invention, and design.

Of scarcely less importance in German industrial economy is her elaborate system for the fostering and extension of trade. This includes the founding, in certain industrial centers, of chambers of commerce. These institutions are intended to deal with questions of home and foreign trade in the broadest possible manner.

"There is no question connected with the development of trade interests, of manufactures, credit capacity of foreign countries, advantages to be obtained by treaty stipulations, injuries resulting from measures adopted by other nations in restraint of trade, which is not thoroughly discussed and carefully considered by the many German chambers of commerce scattered over the country. These bodies report to the minister of commerce with regard to the influence and bearing of all such matters, as they are connected with the commercial interests of the various localities, and by petition or otherwise they often secure action through their minister and the minister of foreign affairs which is of great advantage to them."

As the necessary counterpart of this organization at home, the Germans are about to establish a system of commercial attachés, whose agents shall be specially trained for the service and shall form a recognized part of the national representation in foreign countries. The work of the attaché will be similar to that which is now embodied by our own consuls in their "consular reports," many of which, be it said, are admirable documents and worthy of a wider circulation. He will furnish to the home government a statement in detail of the particular commodities which are required in his district, and will keep it informed of the volume and nature of the trade done there by competitors; and, indeed, he will report any facts which might be of service for dissemination among the various local boards of trade above mentioned.

Visitors to the Columbian Exposition at Chicago will remember the truly magnificent display that was made by Germany, and particularly the collection which figured so prominently in the Liberal Arts building. It was a special effort, carefully planned and effectively carried out, and German foreign trade is feeling the stimulus of that costly display at the present moment.

Our brief consideration of this subject suggests that, while it more immediately concerns the commercial supremacy of Great Britain, it has also a practical interest for the United States. In our future commercial development and expansion we shall certainly enter into a most active competition with the two nations above mentioned. It is a question which we shall do well to ask ourselves, whether our native inventiveness and mechanical skill should not be stimulated and rendered more efficient by such a triple alliance of science, industry, and organization as is now carrying Germany to the front by leaps and bounds.

The Serum Treatment of Leprosy.

In the New York Medical Journal for January 18 was mentioned a communication that had been made to the National Academy of Medicine of Bogota by Dr. Juan de Dois Carrasquilla in which he reported cases of leprosy that had been cured or much ameliorated by the use of an antileprous serum prepared by him. It was his second paper on the subject, and was presented before the academy on the 22d of last November; the first had been laid before the same learned body on the 30th of August, 1895. By the courtesy of the academy's permanent secretary, Dr. Pablo Garcia Medina, the same journal has now received a copy of Dr. Carrasquilla's third communication, made on the 24th of June, 1896. In it the author describes in detail his method of obtaining the antileprous serum and his mode of employing it. These we can indicate only in outline. He first bleeds a leper, choosing an adult whose general condition is fairly good. The blood drawn varies in amount from a hundred to two hundred and fifty cubic centimeters. It is received into a sterilized vessel and carefully covered, kept away from the light, and, above all, kept perfectly quiet. In from twelve to twenty-four hours the superficial layer of serum, that only which is perfectly limpid, is removed with a pipette. If it has to be kept for some time before it is to be used, it is passed through a layer of powdered camphor contained between two layers of cotton, to preserve it, and it is kept away from light and heat.

Thus prepared, the serum is injected into an animal that is refractory to leprosy, preferably a healthy young horse in good condition. Roux's method of procedure is employed. In regard to this operation, says Dr. Carrasquilla, there are two points that are of the greatest importance and at the same time difficult to determine—the amount of serum to be injected at one time and the interval that should be allowed to elapse between the injections. His experience leads him to think that forty-five cubic centimeters is the proper medium dose, given at intervals of ten days. The horse is bled in from five to ten days after the last injection, preferably from the jugular vein. The Nocard-Roux process is followed for obtaining aseptic horse serum, and it is treated in exactly the same way as the human serum.

The dose of the serum for use on the human subject is from one to five cubic centimeters, according to the strength of the serum, the constitution, age, and other circumstances of the patient, the period of the disease, etc., given subcutaneously. The locality to be preferred for the injection is that bounded by the iliac crest and a transverse line passing just beneath the trochanteric fossa, or, better still, just to the outer side of the trochanter major. Great care must be taken to make sure that the serum has not undergone any septic change. A full day should intervene between the injections. Febrile reaction follows in all cases, and the injection should not be repeated until this has subsided. Dr. Carrasquilla gives many other details, which we have not space to mention, and promises to publish further reports of results.

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The Death of Lilienthal.

The following letter appears in Nature of recent date: C. RUNGE.

Dear Sir: You are right in presuming that I can give you details referring to Otto Lilienthal's death, authentic as far as they can be obtained.

As early as the beginning of last spring, Lilienthal's experiments had taken a new departure. He had gradually come to the conclusion that the surfaces employed by him were not sufficient.

With a surface of twelve to fourteen square meters he could take sufficiently long flights to serve his purpose of observation and practice in strong, gusty wind, but he very rightly considered experimenting in a strong wind to be too dangerous, and with a light breeze about twenty square meters were found necessary. This enormous surface, however, could not be handled with the same certainty and exactness as the older wings, and as his system of steering consisted in shifting his weight within the surface upon which it was suspended, he had hit upon the simple expedient of placing two surfaces one above the other.

This system promised from the beginning to be a very marked advance. In former days Lilienthal had tried, over and over again, to make small paper models that would soar like birds, and had always been disappointed. Now this problem seemed to be solved. These two-story models, which resembled beetles rather than birds, soared in the most astonishing manner. He would let them off from the top of the artificial cone which he had erected at Lichterfelde, and they would take long and sometimes circuitous flights into the surrounding fields, and never showed the slightest tendency to take "headers"—a peculiarity very frequently hitherto observed in soaring models.

These experiments, therefore, seemed to prove that not only would a two-story surface be more easily steered, because a definite shifting of the center of gravity to one side would have a more marked effect (since the lateral extension of the whole structure was little more than half of that formerly used), but would also show a greater stability, a result all the more to be expected, as the center of gravity of the system was placed more than a meter below the upper surface.

Experiments, which were begun without loss of time, seemed to bear out this conclusion. Lilienthal appeared to have suddenly gained in power and in the faculty of shaping his motion at will. It seemed to be only a question of time or opportunity that the great step would succeed of describing a complete circle in the air (which always appeared to us to be the key to a definite, if not complete success), when the disastrous accident occurred which has cost the bold experimenter his life.

The following is, as nearly as I can remember it, the report of the mechanic who used to build Lilienthal's wings, and to help him with his experiments.

On Sunday, August 9, Lilienthal had gone out to the village Rhinow, where he used to practice on the bare sand hills in the neighborhood. Nobody was with him except his mechanic. The weather was exceptionally favorable, a light wind blowing from the east with a velocity of about 5—6 m. per second.

Lilienthal had selected one of these new two-story surfaces, which, in a considerable number of trials from the artificial cone in Lichterfelde, had shown itself to be especially successful. He took one flight, by way of warming to his work, and then prepared himself for a second, and gave the word to his man to look at his watch and note the duration of the flight. The man saw him soar down until he was nearly above the foot of the hill, then suddenly a gust of wind set in, lifted him up to a height of 30 m. above the ground—according to his man's estimate—and there he stood apparently motionless in the air.

This was a frequent occurrence, and gave no cause for alarm at first; but now the man saw how Lilienthal gradually lowered the fore edge of his wings more and more without obtaining the desired effect of getting way forward and downward. The man felt uneasy at this, pocketed his watch, and began to run toward the spot where his master was hanging suspended in midair. Suddenly he saw the apparatus heeling over forward still more, and then Lilienthal came down with it with great force head foremost, rolled over once or twice after striking the ground, and remained motionless.

When the man reached the spot, he found the apparatus much shattered, but Mr. Lilienthal apparently uninjured, though without consciousness. The local physician was instantly summoned and at first declared that nothing serious had happened. Lilienthal was brought to the neighboring inn, and within two hours recovered his senses. He seems to have felt no pain, because he immediately declared he would soon get up and continue practicing. However, his arms and legs were lamed. It appears that his spine was fractured.

The man left him to the care of the physician, and took the next train to town to fetch his brother. When the brother came he found that he had swooned again; and he did not recover his consciousness until death set in, which occurred the same night.

By publishing these lines the editor of Nature will, I think, fulfill a duty he owes the scientific world, as well as the memory of a man who, throughout his toilsome life, applied his rare energy, courage, and ability to the solving of a problem which has hitherto baffled the ingenuity of all modern engineering.

Lilienthal, who was a successful engineer and manufacturer, had not lived to see his forty-eighth birthday. He leaves a widow and three children.

Berlin, August 24 A. DU BOIS-REYMOND.

The Bids for the Three New Battleships.

There is matter for congratulation in the fact that there were five separate bidders for the construction of the three first-class battleships recently authorized by Congress; for it proves how rapidly the shipbuilding facilities of the United States are developing, compared with what they were when the reconstruction of the navy was first begun, now some thirteen years ago. The fact that a firm should put in a bid to build an 11,325 ton battleship is evidence that its shipbuilding plant must be thoroughly up to date and capable of turning out the heaviest and highest class of marine work.

It is noticeable that the bids approximate very closely, there being but $85,000 difference between the highest and lowest figures, as against a difference of $285,000 in bids for the Oregon class of battleship in 1890; which goes to prove that our leading firms have acquired familiarity with this difficult class of construction, and have no unforeseen contingencies to provide against. Another noteworthy fact is that the cost of building a first-class battleship is greatly reduced from what it was in 1890. This is shown in the case of the Cramp's Shipbuilding Company, which is now offering to build an 11,325 ton ship for about half a million less money than they asked for the construction of a 10,288 ton ship in 1890; the figures being $3,180,000 for the Indiana of 10,288 tons in 1890, and $2,650,000 for the new ship of 11,325 tons in 1896.

The contracts were awarded as follows: One to the Newport News Dry Dock and Shipbuilding Company for $2,595,000; one to the Union Iron Works, of San Francisco, for $2,674,950; and one to William Cramp & Sons Ship and Engine Building Company, Philadelphia, for $2,650,000. Other bidders were John H. Dialogue & Sons, Camden, N. J., $2,661,000, and the Bath Iron Works, Bath, Me., $2,680,000. The Union Iron Works secures one of the ships by virtue of an allowance of 4 per cent, which is made to cover the cost of transporting materials of construction across the continent.

The new warships will embody the best features of the three types of battleships already built or building for the navy, viz., the Indiana, the Iowa and the Kearsarge. They will have the heavy armor of the Indiana, the high freeboard and weatherly qualities of the Iowa and the powerful rapid fire battery of the Kearsarge. It will be noted that the 8 inch guns of the Indiana and Kearsarge type are wanting, but as an offset to this the new ships will carry a powerful battery of fourteen 6 inch rapid fire guns; and, while many admirers of our present ships will regret the absence of the 8 inch guns, it must be admitted that the change is in agreement with modern practice, and that it is warranted by the effective work done by the heavy rapid fire guns in the late Japanese war.

The general dimensions and principal features are: Length on loadwater line, 368 feet; beam, extreme, 72 feet 2·5; freeboard, forward, 19 feet 6·9; freeboard, aft, 13 feet 6; normal displacement, 11,325 tons; mean draught normal displacement, 23 feet 6; indicated horse power (estimated), 10,000; speed in knots an hour (estimated), 16 knots; normal coal supply, 800 tons; and total bunker capacity, 1,200 tons.

The main battery consists of 4 thirteen inch and 14 six inch rapid-firing breech-loading rifles, and the secondary battery of 17 six pounder and 4 one pounder rapid fire guns, 4 machine guns, and 1 field gun. Four above-water torpedo tubes are placed two on each broadside, amidships, and will fire through an arc of 60 degrees.

The main turrets for the 13 inch guns carry 15 inches of Harveyized armor, and the 6 inch battery, of which four guns are mounted on the upper deck and ten on the main deck, is protected by six inches of the same armor. The waterline belt of Harveyized steel will be 7½ feet deep and 16½ inches thick. The protective deck will be 2¾ inches thick and will be continuous from stem to stern. The engines will be of the usual triple expansion marine type, and steam at 180 pounds pressure will be supplied by eight large single-ended boilers.

There will be no speed premiums; but a penalty is imposed at the rate of $25,000 for each quarter knot that the ship falls below the contract speed of 16 knots an hour.

A MEDAL, called the Neumayer medal, will be conferred soon by the Berlin Geographical Society on persons who have distinguished themselves in geography or meteorology, in honor of the seventieth birthday of Prof. George Neumayer, who, after having been director of the Melbourne Observatory, has since 1870 been at the head of the Marine Observatory at Hamburg.

How Roquefort Cheese is Made.

It is supposed that hundreds of years ago the south of France was disturbed by volcanic eruptions, which slit up the ancient granite rock, causing streams of lava to flow from them. The new surface consists of basaltic rock, which in its turn was fissured by eruptions and thrown up on a mountain range. The whole of the interior of a mountain was thus formed into caverns and caves, which belch forth hot sulphurous springs. It is here that the celebrated Roquefort cheeses are made.

The village of Roquefort is situated on the Mountain Larzac, which is about twenty-five miles in length and nearly 3,000 feet high. It consists chiefly of limestone, covered with sufficient pasture to feed the 300,000 sheep kept for their milk. The caves, being formed by the displacement of rocks, consist of an intricate labyrinth of open spaces and passages connected with each other and with a subterranean outlet. A cool current of air, therefore, always of the same humidity and temperature, flows in a never interrupted stream through the caves.

There is nothing in the milk or in the preparation of the cheeses that gives them that peculiar flavor and delicious mellowness for which they are so renowned. This is entirely effected by the method by which they are cured.

When the cheeses are ready for treatment they are taken to the caves, and after being allowed to cool are carried to the salting room. They are rubbed with salt on one face and then piled on the top of each other until the cave is full. After standing for twenty-four hours or so, the reversed side is salted, and once more they are piled up as before. The cheeses have to be frequently reversed, in order that the moisture may be even throughout, and to develop the fungus which has previously been sown in the curd.

In forty-eight hours the cheeses become viscous, and are rubbed with a coarse cloth. In the course of another two days the fungus will appear on the outside, in the form of a sticky paste. This is carefully scraped off with knives, together with a thin stratum of crust, and set aside for food.

The cheeses are now sorted out; the most solid ones placed on the floor. In eight days' time they become covered with a yellowish red mould, together with other minute vegetation, which is removed and given to the pigs. The scraping is continued until the character of the mould changes, showing that the curd has altered its condition, and announcing the completion of the cure. Then they are again carefully scraped and wiped, and wrapped in tinfoil, and are ready for the market.

Roquefort cheeses have been cured for centuries by this process, and stand as a triumph of uneducated art. —Commercial Gazette.

Protective Sounds and Colors.

In the July number of Natural Science, Mr. R. I. Pocock describes the stridulating organ in the Indian and African scorpions and argues that it is protective in character. He writes: "Since the organs that have been here described are equally well developed in both males and females, and appear in the young long before the attainment of maturity, there is no reason to suppose that they are of a sexual nature, serving, like the chirrup of the cricket or the call of the cuckoo, to inform the one sex of the whereabouts of the other. If this were the case we should expect to find, first, that the organs were exclusively confined to one sex, or, at all events, better developed in it than in the other; and, secondly, that they put in an appearance either just before or simultaneously with the reaching of the adult stage. Again, in spite of the opinion of many authorities, who maintain that the existence of a sound-producing organ implies of necessity the existence of an auditory apparatus in the same individual, we can only assert again that there is not a particle of evidence that either the large spiders or the scorpions can hear the sounds that their own stridulating organs emit. All the available evidence goes to show that in these groups of arachnids the organ is brought into use when its possessor is under the influence of irritation or fright, exactly as in the case of the rattlesnake's rattle. Like the snake too, both the scorpions and the spiders are furnished with highly developed poison glands, and it is a well known fact in natural history that animals so gifted are frequently rendered conspicuous by bright and staring colors, so that they may not be destroyed by carnivorous creatures in mistake for other harmless and edible species. Nature, in fact, for purposes of protection, has labeled them with her poison badge; and apparently with the same end in view, she has supplied the rattlesnake and the large spiders and scorpions with a sound-producing apparatus, which, when in action, serves as a danger signal to meddlesome intruders, warning them to beware of hostile interference."

On the other hand, it appears from experiments made by Mr. Frank Finn, says Science, that the lizard eats indiscriminately plain colored and bright colored butterflies, the supposed protective coloring not being of use in this case.

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THE RIGID SUSPENSION BRIDGE AT LOSCHWITZ, SAXONY.

(Continued from first page.)

in effect near the vertex, the hinge was placed considerably above the roadway frame.

As far back as 1861 * attention was called by Claus Koepcke, the engineer of the Hanoverian Railway, to the fact that the proposed hinge system was applicable to arched bridges, also; and three-hinged arches were recommended by him. Since then, a number of three-hinged arched iron bridges and roofs have been constructed; a notable example being the roof of the Manufactures and Liberal Arts building at the Chicago Exposition. The "Flora" horticultural establishment at Charlottenburg, near Berlin, was the first roof example; and good instances of three-hinged suspension bridges are seen in the 80 meter = 262 foot foot-bridge at Frankfort-on-the-Main, one over the Tiber at Rome, and the 244 meter=800 foot Point bridge over the Monongahela at Pittsburg.

More recently we have the Tower bridge over the Thames at London, the two side spans of which, each 305 feet = 92 meters long, are each composed of two unequal sections, one 188 feet = 57 meters and the other 117 feet = 35 meters, hinged at pillars and at center of length; and the same system is applied in Koepcke's bridge between Loschwitz and Blasewitz, over the Elbe, just above Dresden.

Although this bridge was designed only for ordinary street traffic, it would safely bear a double track steam railway. There is a carriage road 7 meters = 23 feet wide, and on each side a footway 2·06 meters = 6·75 feet; the clear distance between railings being 11·12 meters = 36·5 feet. Provision is made to attach brackets to prolongations of the cross beams, outside of the girders, for the support of two additional footways, should these be demanded by increase of traffic.

The center span is 146·68 meters = 481 feet long, with a height of 24 meters = 78·7 feet. The main chain is an inverted arch, the curve of which is an hyperbola having the vertex equation

$$y = 1{\cdot}871\sqrt{40x + x^2}$$

x and y being the vertical and the horizontal co-ordinates respectively.

Each side span is 61·76 meters = 202·6 feet. Their main chains are in circular arcs with 375 meters = 1,230 feet radius. Their bottom flanges are straight, and rise with a gradient of 0·0225. The vertex, with average temperature, rises 0·608 meter or with an inclination of 0·0083.

The side girders are connected at the abutments to loaded levers or anchors, each built in a room 10·5 meters = 34·4 feet long, and transferring the pull of the bridge through four working points to the abutments, which it reaches at a depth of 7·5 meters = 24·6 feet below the roadway.

The constructive weight of each anchor is 225 tons;† its load is in all about 1,535 tons.

As additional anchorage, the lower anchor frames are placed in niches of the abutments, the weight of which latter would effectually aid in holding down the structure, even if the normal bridge load (calculated at 400 kilogrammes per square meter = 82 lb. per square foot) should be trebled.

As two railway trains, occupying the whole distance between girders, would load the bridge only to 480 kilogrammes per square meter, or 100 lb. per square foot; and as in case of widening the bridge to the extra outside footways 2 meters wide, on brackets, the constructive parts would have a load of only 50 per cent more than at present possible, it may be safely assumed that this bridge is safe beyond all possibility of doubt. The cross beams are laid diagonally, and intersect each other; one of each crossing pair having a height of 115 cm. = 3·77 feet and the other of 94 cm. = 3·08 feet, so that their flanges are uninterrupted. To counteract the interruption of the webs of the wider beams, there are at each crossing four angle irons. Between every pair of wide cross beams there is placed, to divide the interstice to be bridged by iron sheets of inverted U section, a rolled I beam. To prevent rusting, this I beam rests on bars 2 cm. = 0·787 inch square, laid along the middles of the wide cross beams and of the rolled beams. The gaps in the U shaped flooring are covered by sheet iron, on which there is a sheeting of fir wood filled with asphaltum, which slopes from the center line of the roadway to the footways at each side, and carries an oak pavement in which is laid a double track electric railway.

The footways are formed of two crossing diagonal layers of planks, borne by three lengthwise stringers resting directly on the U irons.

The material of the bridge is chiefly Siemens soft basic steel, with a breaking strength of 51,000 to 64,000 lb. per square inch, having 20 to 30 per cent elongation in 20 cm. = 7·87 inches. The elastic limit comes between 30,000 to 40,000 lb. per square inch, and the area reduction at the breaking point is 40 to 65 per cent.

The bed plates on the masonry are cast iron, and the square blocks between them and the anchors, as well as those between the rollers and the pillars, are of cast steel.

The foundation, which rests on solid gravel, has been made within sheet piling, the masonry is cement concrete and quarry stone covered with sandstone.

The total weight of iron and steel in the girders and anchors is 3,800·5 metric tons, which, together with the lead slag, wooden roadway and footways, with two sets of tramway tracks, gives a total weight of 6,708·7 tons.

The total permanent load of the girders is 2,787·2 tons.

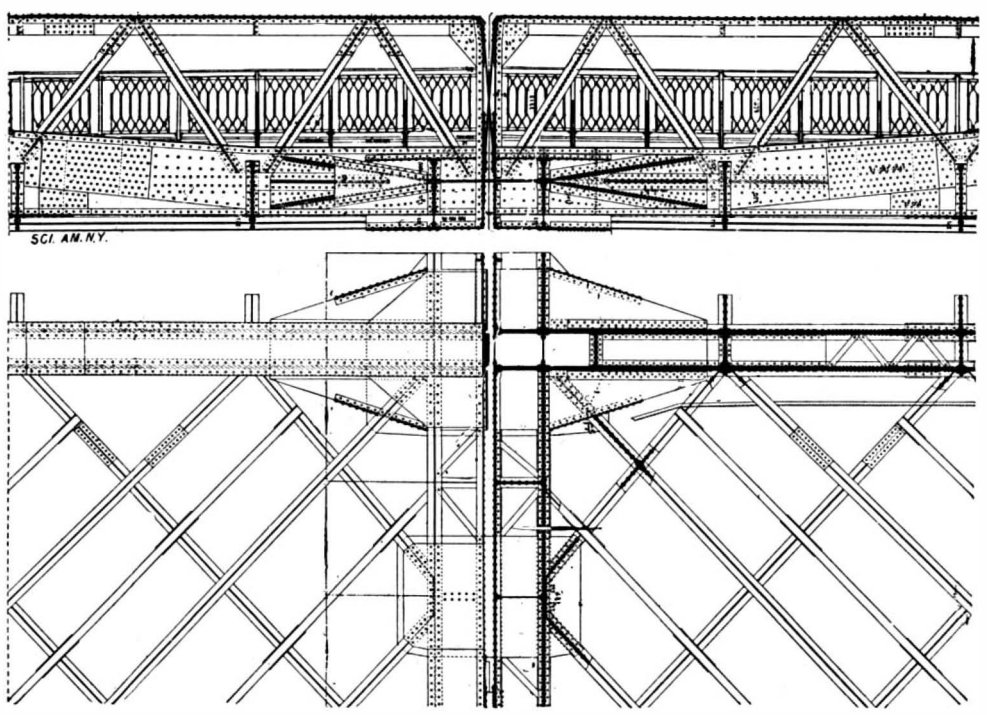
This load of 2,787 tons, distributed over 270·2 meters = 886·5 feet, gives 10,316 kilogrammes per meter (=20,800 lb. per yard) run.

The movable load is estimated as 736 lb. per square yard, or 8,968 lb. per yard run.

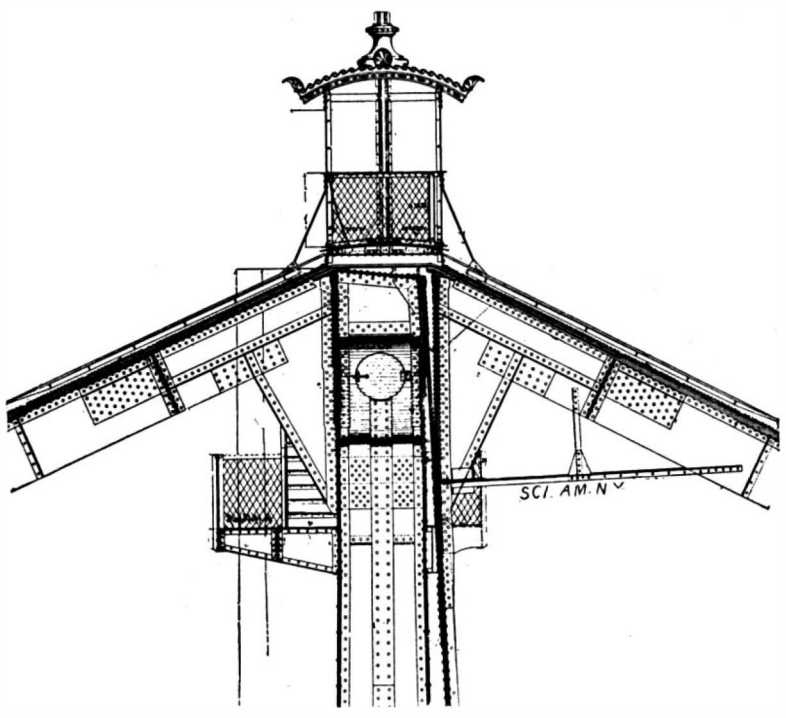
The maximum horizontal strain is 826 tons for each girder.

The minimum stress caused by the bridge weight is 1,158·6 tons, or 579·3 tons per girder.

This bridge was built for the Saxon government, from the designs of Geheimerrath Koepcke and Mr. Manfred Krueger, the latter of whom was resident engineer. The builders were the Marienhuette firm, of Cainsdorf, near Zwickau.



SPRING HINGE AT VERTEX OF MAIN HINGE.



SPRING HINGE AT TOP OF PILLARS.

In the construction of the bridge there are introduced many innovations, the principal of which are:

(1) Making the pillars part of the girders.

(2) Using springs in the hinges.

(3) Putting the center hinge at the level of the bottom member.

(4) Using cross beams in net-like arrangement.

(5) Taking the pull of the bridge with loaded levers.

(6) The use of the "bridge brake."

(1) All previous suspension bridges had masonry or iron columns to support the chains or girders; as at Frankfort, Pittsburg, Wheeling, Brooklyn, Niagara, etc. In some cases (as at Rome, Italy) iron levers were used. But here the pillars form the back frames of the center girders. This gives great stability against wind and centrifugal force (as proved during severe equinoctial storms), and permits expansion and contraction from load and from temperature changes. The pillars are supported by square swing blocks on rollers resting on cast iron bed plates, weighing 7,632 kg. = 16,850 lb. each. The total movement of a pillar between the extremes of minimum load in summer and no load in winter is 7 cm. = 2·8 in.

The stone piers, which get but slight horizontal pressure from rolling friction, have the maximum vertical pressure of 1,090 tons from each of the four pillars. The bottom members of the side spans are kept in position by toes sliding lengthwise in the pillars, and hence are held against lateral pressure, besides being braked against longitudinal vibration as described under (6). Internal spiral stairs give access to summits and bases, and, in fact, to all parts, of the pillars, for the purpose of inspection, painting, or repairs.

(2) The use of springs in the hinges was suggested by the bad performance, in common suspension bridges, of pin joints, which have been in some cases found entirely immovable. An instance of this was discovered at the Tetschen bridge over the Elbe, when Fraenkel found all the deformations of the chains, whether by load or by temperature, to take place only by bending of the links, in consequence of which discovery the permissible traffic had to be reduced.

Now, while the halves of a rigid suspension bridge may not be so flexible as a single chain link of a common suspension bridge, the friction, if pins were used, might cause bending of adjoining parts of the girders; especially as the pins must be of large diameter.

The spring link principle * consists in producing at the joints pulling resistances in two crossing directions; hence care must be taken that the combination of stresses by direct pull and by bending do not exceed certain limits. The angular motions in three-hinged arches or in three-hinged suspension bridges are caused more by temperature changes than by load variations.

In this bridge the angular motions of each pillar, both sides of the vertical axis (the motionless point being nearly in the center of height of the pillar, or 12 meters = 39·4 feet) is $\frac{0{\cdot}07 \text{ m.}}{12 \text{ m.}} = 0{\cdot}00583$, or about 20 minutes of arc.

The vertical motion of the vertex is therefore (the half span being 73·34 m. or 240·5 ft.) 73·34 × 0·00583 = 0·42 m.; or 21 cm. = 8·3 in. above, and the same below, the neutral position. 1° C. = 1·8° F. change of temperature causes 4·5 mm. = $\frac{3}{16}$ inch motion at the vertex.

The stress in a spring of the thickness d or the coefficient θ of change of its length, l, in consequence of bending it to an arc, w, may be found from the equation

$$\vartheta = \frac{dw}{2l}$$

Now the middle horizontal spring is made up of three parts: two side parts each of two plates of 2 cm. = 0·8 in. thick and 100 cm. = 39·4 in. wide by 165 cm. = 68·9 in. long, and a middle part made of four plates of the same thickness, 54 cm. = 21·3 in. wide and 330 cm. = 130 in. long; the cross sectional area being 1,232 sq. cm. = 191 sq. in.; the greatest tensile stress is therefore

$$\frac{826000 \text{ kg.}}{1232} = 670 \text{ kg.}$$

As the angular motion at the vertex is double that at

* See Civil Engineer and Architect's Journal of that year.

† All the tons here mentioned are metric, of 2,205 lb. avoirdupois; the difference between these and our legal tons being unimportant.

* Published in the Zeitschrift of the Hanoverian Engineers' Association, 1889.

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the pillars, we have $\theta = \frac{2 \times 0{\cdot}00583 \times 8}{2 \times 330} = 0{\cdot}000141$

The coefficient of elasticity being about 2,000,000 kg. per square centimeter = say 28,446,000 lb. per square inch, this θ corresponds to a change of tension of $0{\cdot}000141 \times 2000000 = 282$ kg. $= 619{\cdot}6$ lb., or to a change of $\frac{282}{2} = 141$ kg. $= 309{\cdot}8$ lb. greater and less than the stress at the middle position. Therefore the tensions in the horizontal spring at the vertex will vary between $670 + 141$ and $670 - 141$; or 811 and 529 kg. per square centimeter or 11663 and 8676 lb. per square inch.

As the spring plates are not riveted together, and hence each one may bend separately, the difference in tensions in the uppermost and the lowermost fibers is only ¼ of that above calculated; the other ¾ of the 141 kg. being manifested as a difference of tensions, common to all constructions. There is, then, nothing risky in using springs or plates for hinges, as the materials will sustain the bending without damage, the more so as the maximum temperature changes occur only at long intervals, and the changes caused by load variations are but a small proportion of those caused by temperature changes.

The double vertical plates in the center withstand the shearing stresses caused by loads passing that point. The springs at the abutments have but slight angular motion—that due to flexure of the side span girder by load variations, temperature changes being here without influence.

Similar spring hinges have been applied to small cantilever bridges in Dresden, to prevent lifting of the girder ends on the four points of support.

(3) The vertex hinge has been put below the roadway surface to get the necessary horizontal stiffness by making the roadway framework a nearly straight girder with uninterrupted flanges, connected by the cross beams, which here form the wind bracing. All other suspension bridges have the vertex considerably above the roadway, to get necessary vertical stiffness. Thus in these others the transmission of stresses through the vertex distorts the connecting members and causes injurious horizontal motions of the whole girder.

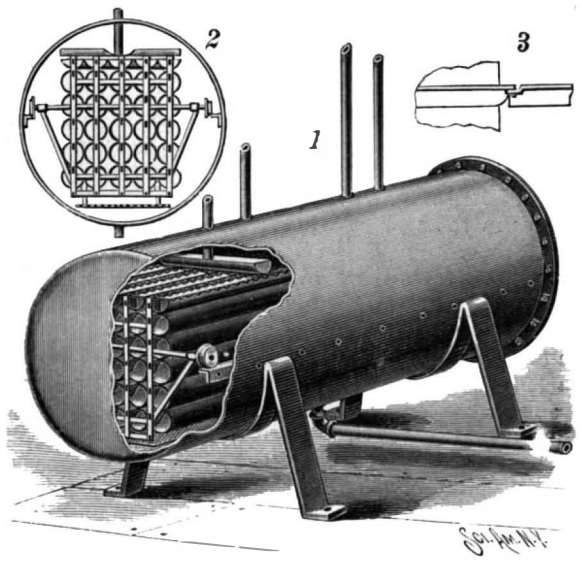
Besides this, there is difficulty in making the hinges as single links (as in the Thames and Monongahela bridges) with pins, for heavy stresses, as the narrowing of the free space between the girders must be avoided. On the contrary, the total breadth of the plates forming the two main springs at the vertex of the Loschwitz bridge is 2·8 m. = 8·5 ft., and besides these, there are also two horizontal plates under the roadway, connecting the hips of the cross beams; and a pair of vertical plates for carrying the vertical stresses caused by moving loads passing the center opening. Thus considerable additional stiffness in the roadway has been obtained. The diagonal cross beams take part of the lengthwise stresses; while they also resist shearing effects, such as those caused by the wind blowing unequally on the different halves of the girder. These connecting springs could only be applied by placing them below the roadway.

(4) Transverse beams crossing each other diagonally so as to make a horizontal lattice which stiffens the bridge against wind and passing loads were recommended as far back as 1860, in the Hannoversche Zeitschrift; and in 1861 in the Civil Engineer and Architect's Journal of January 1.

The value of this bracing, together with the position of the middle hinge at the level of the lower flanges, in the Loschwitz bridge, may be seen in the fact that its lateral motion during the passage of thirty-six men keeping step was but 0·45 mm. = $\frac{1}{55}$ inch.

Although special diagonal bracing may be strong enough statically, the greater changes of length by tension and compression in such special bracings, which are, of course, weaker than the cross beams, increases the lateral flexure and hence the oscillation period. The matter of oscillation of bridges is more appreciated of late years than formerly, the conviction gaining ground rapidly that horizontal vibrations are as injurious to durability as vertical ones are.

(5) Loaded levers to counteract the push of an arch were applied to the street girder of the bridge over the Elbe at Riesa. The chains or cables of suspension bridges are usually anchored to the natural rock or confined in walled abutments; but there is seldom any precaution taken to permit easy access to all parts of the anchorage system, which last has often been rapidly destroyed by rust. The anchors of the Loschwitz bridge are accessible in every part, so that their coat of coal tar can be readily inspected, and, when necessary, renewed. The anchors bear, in addition to their regular load, the roadway, which covers them, and which is of slag blocks on Monier plate, their ends being inserted into the walls. They cannot give way by any increase of the bridge load within the limits of the bridge strength.



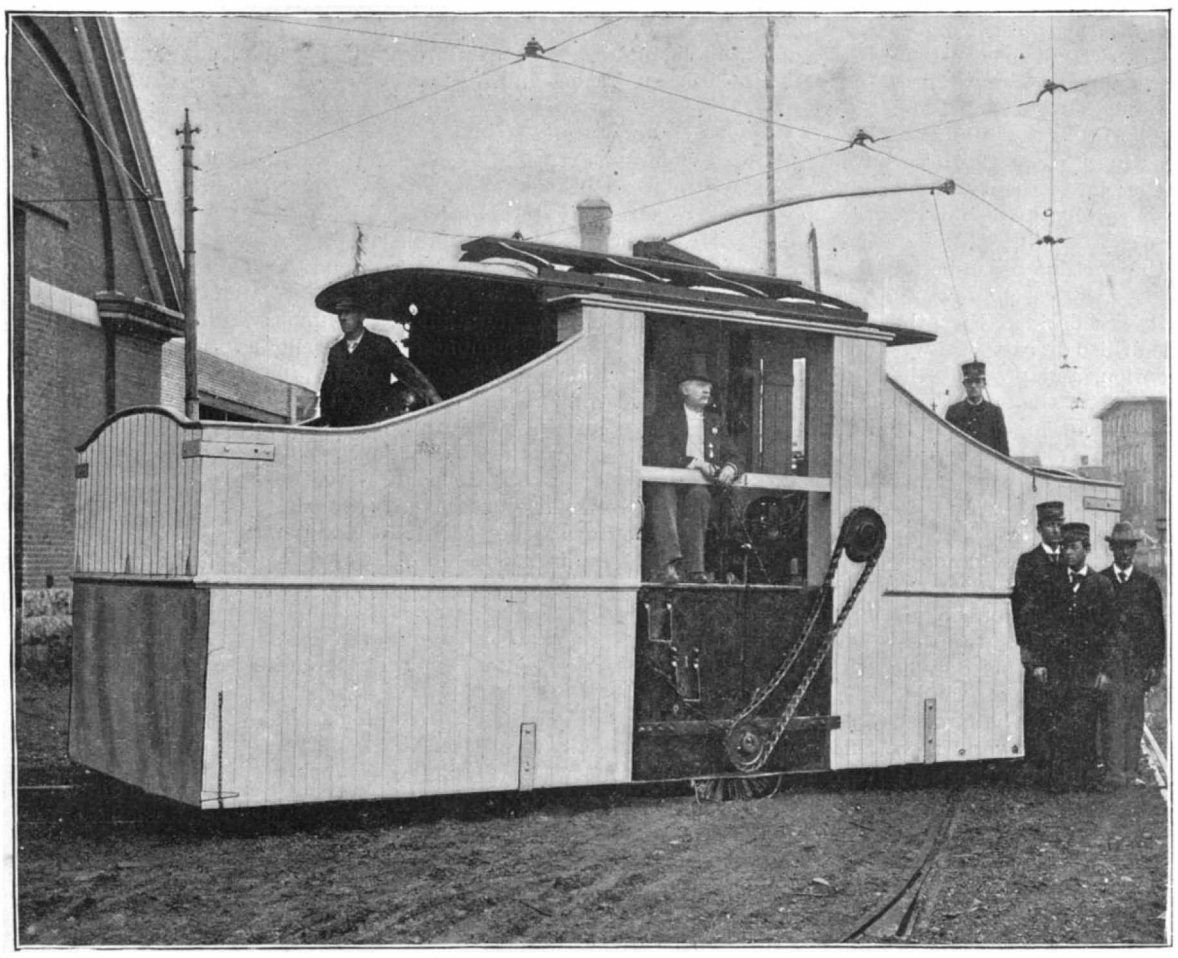
MUNDAY'S FEED WATER HEATER.

(6) The bridge brake consists of clamps which oppose to the sliding or vibratory motion of various parts of a bridge a certain amount of sliding friction, regulatable by springs, by bolts and nuts or otherwise, and thus absorbing much of the vibration or other injurious motion. It is most successfully applied in the bridge here described.

At a trial of the stiffness of this bridge a load of steam and horse road rollers, vehicles, etc., amounting to 150 tons, caused a center deflection of but 9 millimeters, = ⅜ inch, and a company of soldiers marching over it in step caused scarcely perceptible vibration.

AN ELECTRIC SELF-LOADING CAR FOR STREET CLEANING.

Among the many novel applications of electricity one of the latest is that shown in the accompanying illustration, where it is utilized, through the medium of an electric car, for sweeping up and carrying off the street refuse. The car is 8 feet wide by 25 feet long and 11 feet high. It is carried on two axles, and is fitted with the usual equipment of a trolley car. The brakes and the motor are placed above the wheels. The motor is connected by chain and sprocket gear to the driving wheels and to the brush, the brush making five revolutions to one of the car wheels. The brush runs in a cylindrical case which is open at the top and the bottom, and it is arranged to work both ways, a reversible steel deflector being arranged above the brush. The car consists of an upper platform, in the center of which is a shelter or cab containing the motor, and a lower closed section into which the street rubbish is thrown. Its lower floor is formed in parallel sections, which are hinged transversely to the car, and by the operation of a lever can be opened for dumping out the refuse. The broom, which ordinarily, as shown in the illustration, is the full width of the car, can be extended to cover nearly the full width of the street if so desired.



ELECTRIC SELF-LOADING CAR FOR STREET SWEEPING.

In operation these cars are used in connection with manual labor, the sweepings of the gutters and sides of the street being thrown toward the center, where they are picked up by the car, which thus sweeps its own section of the road, and also takes the place of the refuse carts.

The car is the invention of A. Jackson Reynolds, of Montreal, who states that when sweeping it travels at the rate of six to eight miles an hour, and that it carries refuse, snow, etc., out of the city at a cost of $2.50 per mile. For removing snow a car specially wide and long is constructed; and it is claimed that by running the car continuously during a snow storm there is no difficulty in keeping a street open. A self-loading car is now being built which will be one of the largest street cars in the world, being 8½ feet wide and 45 feet in length. It will have a capacity for cleaning 25 miles of street without stopping.

AN IMPROVED FEED WATER HEATER.

The illustration represents a heater in which troughs connected with the supply pipes distribute the water over tubes in thin streams or a thin sheet, within the shell of the heater, with whose upper portion steam inlet pipes are connected. The improvement has been patented by George T. Munday, Brenham, Texas. On opposite sides of the interior of the shell are secured angle irons forming tracks, on which the tubes are removably supported by means of a supporting frame at each end. as shown in Fig. 1, and in the sectional view, Fig. 2, a transverse shaft of the frame carrying rollers which travel on the tracks. The tubes are open at their ends, to permit the free circulation through them of steam admitted to the heater, and extended above the tubes are troughs supported by the end frames, the edges of the troughs being serrated to cause the breaking up and fine distribution of water flowing from them, each feed pipe discharging into transverse troughs. Below the tubes is a wire cloth screen, also supported by the movable frame, designed to receive falling scale, and in the bottom of the shell is an outlet blow-off pipe. When the tubes and troughs are to be removed from the heater, for cleaning and the removal of scale, the head of the shell is taken off and extensions of the angle iron tracks, as shown in Fig. 3, are connected with the ends of the tracks within the heater, the outer ends of the track extensions being supported in any desired manner, when the whole interior mechanism may be readily drawn out. It is designed with this heater to heat the water as nearly as possible to the temperature corresponding with the boiler pressure, and effect the rapid formation of scale, which may be removed with but little trouble.

PROF. WM. H. BREWER contributes to the Yale Scientific Monthly an account of observations during the past 45 years on earth tremors at Niagara Falls. The heaviest vibrations were on either side of and near the Horseshoe Fall. They disappeared in places in the soft shales below the limestone, although they were evident in the harder limestone and sandstones that occur amid these. Passing down along the gorge, the vibrations decreased in intensity, becoming too faint to be perceived between the suspension bridges, but increasing again on nearing the rapids. Persons living near the falls believe that crystals are more common in the rocks there than elsewhere, the texture having been affected by the jar of the cataract, but Prof. Brewer finds no evidence of this.

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Inventions.

Mr. Horace L. Arnold, in the American Wheelman, is correct in saying that a great deal has been written to exactly define what constitutes invention. Some very skillful and ingenious minds say there is no such thing as invention, and others advocate the view that the simplest and most obvious combination of old and well known elements is an invention. One view makes nothing whatever an invention, and the other makes anything an invention and the proper subject of a patent in case it has not been "anticipated" by exactly the same combination.

The courts are constantly called upon to decide whether the "subject matter" covered by the claims of a patent is an invention or the mere handicraft of a skilled workman, and sometimes the courts decide that what seem to be really intricate inventions are not inventions at all, or that extremely simple things are real inventions and fit subjects for patents.

The point of view seems to be this: If the alleged inventor has done no more than a mechanic skilled in the art might do in the way of meeting the demands of the situation, he is not an inventor, he has not made an invention, and should not have a patent. But if what the alleged inventor has done was a stepping out of the beaten path, and required original thought, which may be defined as either finding new and better answers to old questions, or the first sufficient answer to a new question, then the result of his thought is invention, and the fit subject for a patent.

For illustration, take a cycle frame of the now universally adopted "diamond" pattern, made of tubing. The use of tubing could never have been the subject of a patent, because any skilled mechanic knows that a large hollow thing is stronger and stiffer than a small solid piece of the same weight. But had the "diamond" frame been brought out complete, all at once, by one designer in its present form, that arrangement of frame members would have been an invention, and might have been made the subject matter of one of the most valuable patents ever issued. In fact, the "diamond" design for a cycle frame was of slow growth, and the outcome of successive approximations. Even so, it seems quite likely that had the man who was first to combine these preceding approximations, and produce exactly the now universally used form of the diamond frame, applied for a patent, he would have had it issued to him and it might have been sustained by the courts, and every cycle made might now pay a royalty to the lucky Coventry man who, it is said, was the first one to show the diamond frame.

I have said that the courts are continually called upon to decide what constitutes an invention, and some of these decisions are evidence of very clear thinking on the part of the judges presiding. Often several judges sit together on a case, and they are not always unanimous in conclusions; the decision goes with the majority, one of whom writes all the considerations and premises and influencing circumstances which lead the majority of the judges to their decision, and this goes on file and into print as the opinion of the court in the matter. Sometimes where the decision is not unanimous a dissenting judge writes a little dissenting opinion, and that is printed, too; but the dissenting opinion does not carry weight, although where all the judges concur the decision has a better front.

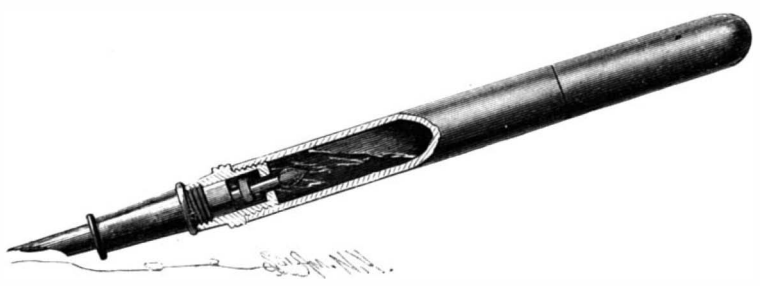
In a very recent decision it was decided that the direction in which a little hole drilled in cast iron was inclined was a matter of invention, and properly the subject of a patent, even in the face of the fact of previous unintentional use. The invention related to those gas fireplace logs which have asbestos moss on them and look, when in use, as if they were being burned, although the fire is really that of burning gas only. It is desirable that the gas flame should lie close to the cast iron fire logs, and that there should not be a little explosion when the gas is turned off. If the little holes through which the gas comes out of the hollow cast iron fire log to be burned are drilled at a sharp angle to the surface of the log, then the flame does lie close, and there is no explosion at the time of starting or stopping the fire. Yet, as the logs are half round and were laid on a driller table to have several rows of holes drilled in them, it had always been the practice to drill part of the holes inclined and part at nearly right angles to the surface of the fire log. The invention claimed lay in drilling all the holes at about the same acute angle to the face of the fire log, with the outer opening of the drilled hole higher than the inner opening, which avoids the explosion and makes the flame lie close to the log, and gives more heating effect for the same amount of gas burned.

At first sight it would seem that this was a very thin invention; it was shown, however, that it was of commercial value, as making a better and more economical fire log, and it was held that the previous accidental drilling of angular holes lacking uniformity of angular direction was merely slovenly work, while the drilling of the holes all at about the same angle to produce certain valuable results, and the gaining of these valuable results by this intentional uniform angularity of the gas jet holes, was invention, and to be considered the more meritorious because of its extreme simplicity.

In general terms, if a new and valuable result is gained, no matter how simple and slight the changes made to gain the novel effect, the courts sustain the patent. It is hard to avoid the conclusion that there was original reasoning used to gain a new effect from very slightly modified well known means, and when, as is often the case, the new effect gained by such a slight change in old means is commercially valuable, the patent is almost always sustained.

THE "CLIMAX" FOUNTAIN PEN.

The illustration represents a new fountain pen which forms the subject of two recently issued patents. The pen is designed to write to the last drop of ink, without any liability to leak, and the flow of ink can be easily and instantly regulated to suit the writer or stopped entirely, enabling the pen to be carried point down in the pocket with absolute safety. The chief feature of the pen is that, by means of a nozzle revolving in a plug, the ink duct can be instantly shut or opened, the flow of ink increased or diminished, and all superfluous ink withdrawn from the nib of the pen and stored in cells or basins, where it remains perfectly air bound as long as the pen is out of use. The picture represents a small size of the pen, which is being introduced by the Climax Fountain Pen Company, of No. 130 Broadway, Brooklyn, N. Y. As may be seen in the broken away section, when the nozzle is turned downward into the plug the ink duct is opened, and the ink is forced into the nib by air pressure; but when the nozzle is turned upward the ink duct is closed, and a reversed suction takes place by which the ink is withdrawn from the nib of both the pen and feeder. The feeder is so constructed that, when the flow is regulated, blotting and leaking are impossible, as hardly a drop of ink can be forced out, even by violent shaking. The inside shaft of the feeder has an automatically sliding valve keeping the ink always in fine flowing condition, and the pen, when necessary, may be washed without removing any single part, simply by holding it, point up, under the open faucet. Patents have been granted for this improvement in the United States and Canada, and other patents are applied for in England, Germany, France and Austria.



THE "CLIMAX" FOUNTAIN PEN.

Thomas Jefferson as Meteorologist.*

The following items are extracted from notes furnished to the editor by the gentlemen named below. Further interesting remarks on this subject will be found in articles by Mr. Alexander McAdie, published in the Popular Science Monthly, vol. xlv, p. 331, and in Weather Bureau Bulletin No. 11.

Monticello (in Italian "Little Mountain"), the home of Thomas Jefferson, is on the summit of Monticello Mountain, on the south side of the Ravenna River, in Albemarle County, and three miles southeast of Charlottesville, Va. This mountain, which towers up more than five hundred feet above the general level, commands a magnificent view of all the country to the north and east. The birthplace of Thomas Jefferson, called Shadwell, named after the parish in London where his mother was born, is a couple of miles away.

The general appearance of the Monticello mansion has undergone no alteration or change since Mr. Jefferson's death. The central portion consists of two stories, with a dome surmounting the center; the wings are of one story and attic.

Mr. Jefferson was one of the pioneer meteorologists of this country. He kept daily records of the temperature and other important weather conditions during the greater part of his life; he induced others in different parts of the country to make records simultaneously with his own observations; he collected and charted the results, and drew from them his own conclusions with regard to the character and movement of storms, etc. These conclusions were remarkably accurate, considering the meager data at his command for such investigations. Photographs and engravings of Monticello show on the roof a part of his instrumental equipment, viz., the wind vane, the construction of which is very similar to the modern vane. The vertical rod supporting the vane projects down to the ceiling of the portico, to the lower end of which is attached an arrow that indicates by its position on a lettered dial the direction of the wind at any moment, and this can be seen from within the house. Mr. Jefferson made and recorded his weather observations several times each day, and these were not neglected even during the performance of his most important and engrossing public duties. In Paris, during a time when his right arm was disabled, in consequence of a fall, his weather records were made with his left hand. Even during the exciting debate in Congress on the document which he had written, one of the noblest in the annals of the world—the Declaration of Independence—when he was writhing under the bitter criticisms with which it was attacked in some of its parts, his observations of temperature were continued. The record in his pocket memorandum book contains the following entries:

PHILADELPHIA, 1776.

	H.	Min.	Deg.
July 1	9	0 A. M.	81½
	7	0 P. M.	82
2	6	0 A. M.	78
	9	40 A. M.	78
	9	0 P. M.	74
3	5	30 A. M.	71½
	1	30 P. M.	76
	8	10 P. M.	74
4	6	0 A. M.	68
	9	0 A. M.	72¼
	1	0 P. M.	76
	9	0 P. M.	73½

For his temperature readings Mr. Jefferson used a pocket thermometer.

*By Fred. J. Randolph and Fred. L. Francis, of the Weather Bureau, in the Monthly Weather Review.

Work Spent in Pressing Pedals.

In a recent communication to the Paris Académie des Sciences, says Engineering, M. Bouny gives particulars of a series of experiments made to determine the power exerted in propelling a bicycle at different speeds. The method adopted was to take an autographic record of the total force exerted on the pedal throughout a complete revolution. To this end a disk was mounted on the bicycle crank concentric with the pedal pin. The pedal itself was mounted on stiff springs, and points fixed to it traced curves on the disk already mentioned. If no pressure was exerted on the pedal, these latter curves were simple concentric circles; when, however, the rider began to work, the springs on which the pedal was mounted yielded proportionately to the pressure applied, and the curves then drawn showed by their deviation from the circular form the value of the force applied at any part of a revolution. One of the pointers in question measured the force applied in a direction perpendicular to the plane of the pedal, while the other showed the pressure applied parallel to this plane. The latter is by no means an insignificant quantity, as all good riders shove their pedal forward as well as down. The angle the pedal made at any moment with the crank was also automatically recorded.

An examination of the diagrams thus obtained showed, in the first place, that there was no absolute dead point, such as occurs with an ordinary connecting rod and crank motion, and, secondly, that there is always some pressure on the pedal during the rise, the negative work due to which has to be subtracted from that done during the down stroke to obtain the net amount used in propulsion. The experiments were made at speeds ranging from 10⅝ to 21¼ miles per hour, the machine being run on a wooden racing track. The results, reduced to even English measures by means of a formula of interpolation, were as follows:

Speed. Miles per Hour.	Work done per Semi-revolution. Ft. lb.
10	18·58
10⅝	20·96
12·5	33·98
15·0	47·50
17·5	56·75
20·0	63·62
21¼	66·08

It will be seen from the above figures that the average pressure of the foot required on the pedal increases rapidly with the speed, being at twenty miles an hour nearly three and one-half times as much as at ten miles per hour. Unfortunately, the gear used is not noted by M. Bouny, and so it is impossible to deduce from the above figures the average tractive resistance of the machine at the different speeds. Probably at the higher speeds named a large proportion of the total work done was expended in overcoming atmospheric resistance, and the run of the figures might be changed considerably if the trials were conducted on a roughish road instead of on a smooth track.

IMPROVED hygiene and sanitation have reduced the death rate in the German army from 6·9 per thousand in 1870 to 2·4 in 1894. During the Franco-German war the French lost 23,400 men from smallpox, while the Germans, who had strictly enforced vaccination for thirty years, lost only 300 men from this disease. Since 1873 only two soldiers have died from smallpox in the German army.

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Correspondence.

Dark Meteors.

To the Editor of the SCIENTIFIC AMERICAN:

In SCIENTIFIC AMERICAN of August 1 I read, under "Astronomical," the observation of Prof. Brooks at Geneva, on July 22. I have the honor of informing you that the observation of dark meteors passing across the disk of the moon is not at all new in astronomical records. Already some years before Prof. Brooks I discovered the phenomenon on April 4, 1892.* This was announced in three papers in the Dutch periodical De Natuur, respectively dated January 3, 1893; September 4, 1893; and January 8, 1894.

Recently, I gave two papers on the subject, the first entitled "Observation de Météores Hors de l'Atmosphère Terrestre" (Bulletin de la Société Belge d'Astronomie, I, No. 8), May 31, 1896, and the other "Mitteilungen über Meteore," in the Mitteilungen der Vereinigung von Fremden der Astronomie und Kosmischen Physik, Jahrg. VI, Heft 8, redigiert von Prof. Foerster, director of Berlin Observatory.†

Some elements of the meteor shower observed by me on September 13, 1895, across ths sun's disk have been calculated by Prof. Dr. Y. A. C. Oudemans, director of the Utrecht Observatory.

The above named articles prove undoubtedly my priority on this subject. On the other side the "cosmic meteors," as I called them, have also been observed, on my suggestion, by Dr. A. A. Nyland, with the great Fraunhofer refractor of the Utrecht Observatory, by some other observers, who assisted me, and by one in Dutch India (isle of Lombok).

I am, dear sir, yours faithfully,

A. M. DU C. MULLER.

Nymegen, Holland, September 2, 1896.

Hunting the Kangaroo.

BY GEORGE E. WALSH.

Twenty and thirty years ago the visitor to Australia could see more kangaroos to the square mile than there are jack rabbits to-day, and it was literally impossible to avoid the countless flocks that swarmed over the whole island. With a good rifle he could take a position on a rock and shoot all day long, until tired of the monotony of the slaughter, or until some "old man kangaroo" became desperate at his killing and decided to turn the tables upon him. In those days men were paid liberally by the sheep owners to kill off the kangaroos, and it is reported that one hunter would kill several hundred a day, and one man is known to have cleared $4,500, free of living expenses, in a single year.

The visitor to Australia to-day discovers a decided change in many ways, but not more so than in the comparative scarcity of the kangaroo. He may reside on the island for a month or two and not get a sight of one of these queer looking animals. He is similarly disappointed as the visitor to Florida who expects to see alligators and diamond-back rattlesnakes crawling about every marsh and lagoon, making life actually dangerous and fearful. The conditions which the pioneers in both places met and overcome no longer exist, and both Florida and Australia are so built up and civilized that the visitor must don the rough clothes of the hunter and hie himself to the desolate backwoods, far away from all towns and railroads, if he would find game worthy of his sporting blood.

There are kangaroos in Australia in numbers sufficient to satisfy the most exacting, but they must be hunted up and their favorite feeding places be located by good guides. The sheep herders caused the creatures to be destroyed in such numbers, before they became of any commercial value, that they are now rarely found outside of the "bush." In some of the private parks and large estates a few semi-wild kangaroos are kept, but they are protected so closely by laws that no one ventures to disturb them.

About three hundred miles back from the coast, thousands of kangaroos can be found. A trip of one hundred and fifty miles back from Melbourne will take the hunter into a section of the wild country where good sport can be enjoyed. The country abounds in straggling bushes, with very few tall trees or woods to obstruct the travel; but the bushes, while in the open country, are tall enough to make good hiding places for the marsupials. They feed on the grass, roots, and leaves, and when startled by a hunter leap over the bushes as easily as a rabbit jumps over the tufts of grass.

We left Sydney one bright afternoon with a party of four hunters and two guides, and started for the interior to try a week at hunting in the Australian "bush." Hunting small and large game in the various States of the Union and Canada had brought its pleasure in times past, but the novelty of hunting kangaroo in their native "bush" excited more feelings of pleasure and anticipation than we had felt for many years. We anticipated little danger, although our guides assured us that the element of danger was always present in shooting these wild creatures. We were armed with good rifles, hunting knives, horses, two good kangaroo dogs, and the various accouterments necessary for any good hunt. The dogs were a peculiar breed of large greyhound. They were much stronger and rougher in appearance than the ordinary greyhound, but they were equally as fleet and capable of running down a kangaroo in the open. They were powerful and fierce enough to attack the largest kangaroo, although the results of the battle were not always in their favor.

Thus equipped for our journey, we took the railroad as far inland as we could, and then started across country on horseback. The land was wild and rugged, overrun with strange plants and tree growths that attracted our attention by their beauty and oddity. Beautiful birds fluttered over our heads, and hissing serpents disputed our passageway. Our guides, knowing the harmlessness of these reptiles, either passed them without notice or hit them over the head with their strong riding whips.

As we proceeded inland the country became more open, but more wild and desolate. The foot of man seemed never to have traversed these lonely wilds. Our first sight of a kangaroo was made on the second day out. While eating lunch in a quiet part of the country, the "bush" around suddenly seemed to become alive with animals. The heads of some strange creatures bobbed up above the bushes on every side, and a peculiar tapping noise on the turf alarmed us. We were on our feet instantly, with rifles in hand, prepared to meet any kind of strange beast. Suddenly in front of us a succession of kangaroos passed, crossing a narrow opening so that we could secure a good glimpse of them. Our guides hastily raised their rifles and shot, but the rest of us were too disappointed to do anything. These diminutive creatures, scarcely three feet high, the famous Australian kangaroo! Why, we expected to see animals seven, eight, and possibly ten feet high, and to have our hopes dashed to the ground in this way completely demoralized our hunting nature. Both natural history writers and hunters must have willfully lied when they described the kangaroo, or else our imaginations had stretched the dimensions to an unwonted degree.

We were considerably reassured, however, a few moments later, when our guides brought in two of the dead creatures, remarking: "They'll make good eatin'. Ever taste paddymelon?"

"Paddymelon! Aren't they kangaroo?" we gasped in unison.

"Strangers that don't know sometimes call 'em that; but they're only paddymelon. We've run across a flock of 'em, an' you can get some good shots at 'em."

This was our first lesson in Australian natural history, and our guides gave us further valuable instruction before the day was over.

"Now you might be a-callin' this creature a kangaroo," one of them said toward dusk, as he suddenly hit something on the ground with his whip, and then picked it up. The creature that he had knocked over was not more than a few inches long, but he was an exact imitation of all pictures we had ever seen of full-grown kangaroos. The well developed hind legs and tail, the peculiar head and ears, the pouch for carrying the young in front, and the dwarfed front paws, were all there. Magnified about twentyfold, and a perfect kangaroo would be produced.

"No, that ain't nothin' but a kangaroo mouse, and he ain't what we're hunting after no more than the paddymelon."

It may be of importance to mention just here that the kangaroo and the kangaroo mouse represent the two extreme types of Australia's strange animals. Between these two extremes there are many other animals with the same essential features and apparently differentiating from each other only by their size. The kangaroo is the largest of the whole class, and next to him comes the wallaroo, then the wallaby, then the paddymelon, a specimen of which we had before us, the kangaroo rat, and the kangaroo mouse. The bush wallabies and paddymelons furnish more general sport to the hunters than the kangaroos, for they are more plentiful and not so timid. They move about the bush with great agility, and resemble shadows more than animals flitting around. It is a true test of one's skill to bring them down. During the next day or two we shot several of these animals, and prepared ourselves for the more exciting sport of kangaroo shooting. The dogs rather despised these smaller kangaroos, and did not offer to chase them unless they felt restive and sportive and needed exercise.

The first kangaroo was sighted on the fifth day out, and he loomed up in the distance so suddenly that we all made an exclamation of surprise. He was five hundred yards away, and our guides informed us that we could not approach much closer without startling him. We drew about one hundred yards nearer and then started to get sight on him. The first bullet flew a hundred feet wide of the mark, and the kangaroo was off in an instant with the speed of an express train.

The next one we ran across we took the advice of our guides and raised the rifle to shoot over the creature, and then gradually lowered it until the distance could be accurately gaged. Instead of being alarmed at this, the creature merely looked up each time and then resumed his grazing. But suddenly the distance was properly gaged, and a bullet struck the animal in one of his fore paws.

Such a wound does not by any means handicap the animal in running, but the pain of the wound seemed to paralyze him, for he circled around several times and struggled and rolled upon the ground as if mortally wounded. The two dogs rushed forward to pounce upon the game. Their deep baying close at hand brought the kangaroo to his senses, and placing himself against a tree he waited for the onslaught. The hounds, expecting to find the animal nearly dead, plunged recklessly forward, and the foremost suffered as a consequence. With one sweep of his sharp, sickle-like hind claw, the old kangaroo nearly disemboweled him. The hound fell over with a yelp and expired in an instant. His companion stood at a safe distance and growled savagely.

At this instant we appeared upon the scene, and seeing so many enemies, the kangaroo suddenly turned and started off at a speed that no horse could attain. We raised our rifles and took a flying aim. Two bullets brought the creature to the earth dead.

The hind legs of the kangaroo are powerful weapons. One long claw, hard as bone or steel and sharp as a knife at the point, gives the kangaroo an implement that can kill a man or beast with one blow. The front paws are not so strong, but an old fellow has strength enough in them to seize a dog and hold him in a helpless position. When chased into the water they will sometimes seize a dog and hold him under the water until dead. On land they will seize an enemy and hold him until the hind claws can cut him nearly in two.

They are also good boxers, and when the natives attempt to kill them with clubs they dodge the implement with all the skill of a professional pugilist, and unless the man is an expert he may get the worst of the encounter. Quite a number of hunters have been severely injured, and some killed, by attempting to corner a wounded kangaroo when enraged by a bullet wound. It is much better to bring the animal down with the rifle bullet, and be sure that he is dead before approaching too close.

The fleetest horse cannot keep pace with the larger species of kangaroos, but with a little tact the hunters are enabled to capture them whenever they are sighted. When the creatures are once started on a run, they will not swerve from their course, but continue straight onward, leaping over bushes, rocks, and all ordinary obstacles. The hunters generally station themselves in the line that the animals are most likely to pursue, and then wait until the dogs or the rest of the party start them up. Several flying shots can thus be obtained, and if one is accustomed to the work he will bring down one or more of the fine creatures.

Exposed Dry Plates on a Tour.

Exposed plates, and how shall we pack them, is one of those troubles always with us when away from home on tour. Many are the methods which from time to time have been suggested, most of them more or less efficient.

During last summer holidays having used what plates had been taken away, some of Belgium make were bought and used. Upon opening them out in the dark room, the careful manner of packing employed was apparent. Each couple of plates were placed face to face, and wrapped up in thin paper. The comfort of handling, both in unpacking and replacing exposed plates in this manner, was such that this method of packing our stock of plates when away from home has been followed with every satisfaction, and can be commended to any in doubt as to how to store them until home be reached again.

It is simply necessary on taking them out of the slides to dust them, place two face to face without anything to separate them, then wrap in thin brown paper, and so on until the whole number are done. Mark on each package in pencil the subjects the plates have been exposed on, and any other mark of identity thought advisable, then put them twelve at a time in the ordinary boxes they were bought in, which may then be wrapped up in stout paper and fastened with wax or string, and when home again they are ready to be dealt with in the ordinary manner.—The Amateur Photographer.

Foreign Bodies in the Throat.

The difficulty of removing fish bones and similar obstructions impacted at the lower end of the œsophagus is well known, and various mechanical measures and appliances have been invented to deal with the difficulty. One of the most simple, however, and, as reported, one of the most effectual, is to administer to the patient a pint of milk, and forty minutes afterward an emetic of sulphate of zinc. The fluid easily passes the obstruction, and is, of course, rapidly coagulated in the stomach into a more or less solid mass, which, on being ejected, forces the obstruction before it and so effects its removal.

* These dark meteors were observed several times more by me, and also passing across the sun.

† Communicated by Prof. Foerster to the Astronomical Assembly at Berlin, on May 26, 1896.

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THE CALUMET AND HECLA COPPER MINE.

BY WILLIAM P. KIBBIE.

The Calumet and Hecla stamp mill, the largest of the kind in the world, is situated at Lake Linden, Mich.

There are practically two mills in one, of eleven ball heads each, and having a capacity of 6,000 tons conglomerate per day.

The metal is found deposited in the rock in all possible forms. The separation of the copper from the rock is effected by passing the stamped rock over a system of jigs, whereby the sand by its less specific gravity is floated off into a steady current of water, and the copper, being the heavier, settles and falls through the sieves. One line of jigs succeeds another, over which in succession the copper, which has just passed through a previous set of sieves, is made to pass, and the sand, which is sustained in the water, is carried away by the current of water to the lake by a system of sand wheels and launders.

The number of jigs and the velocity of the current are so regulated as to secure the desired separation, with very little loss of copper. The Evans slime table is an important adjunct in copper washing; its use in saving copper from the waste, that is, the small particles, is pre-eminent.

The head current of water coming from the stamp heads, in which float the light copper and fine dirt, is turned from the main launder into lateral ducts, which convey it to the large slime tables over whose conical shaped, slow-moving surface it is made to pass.

The stamp mills and copper washing machinery used at the copper mines on Lake Superior have reached a high state of perfection. The advance which has been made in this region in this department of mining work, from the crude iron shod wooden stamps and hand buddles of an early day to the stupendous structures with their intricate machinery that now successfully perform the work, is certainly wonderful. The simple mill, wherein could only be crushed and manipulated a few tons of rock per day, and at a cost too great for a profit, has given place to those with a capacity of 5,000 and 6,000 tons per day, wherein the manipulation is attended with but a tithe of the cost and difficulty which were inseparable from the earlier attempts.

This work has been so perfected that thirty-three cents per ton would cover the entire cost of treating a ton of rock in the stamp mill. Perfect and systematic as the mechanical manipulations in copper mining have become, there is yet a waste of copper in the tailings. This waste varies from one-fourth to one-half per cent, and this in the aggregate product of the Calumet and Hecla mill, which stamps 4,000 tons of rock per day, average, represents a very important value at the end of each year.

At the present time the Calumet and Hecla mill is stamping between 4,000 and 5,000 tons of rock per day.

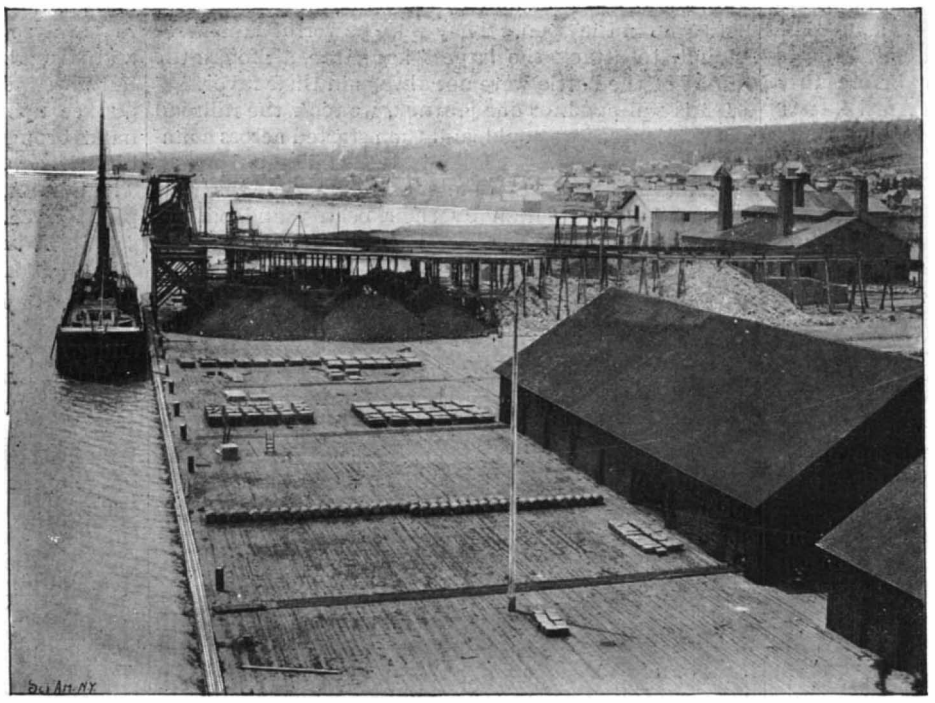
The pumping engine Michigan, the largest in the copper country, has a capacity of 60,000,000 gallons every 24 hours. The engine is of the triple expansion pattern, has steam cylinders 18, 28½ and 48 inches diameter by 90 inches stroke, and is capable of lifting 1,400 gallons at every revolution. Its height from base to summit is 56 feet. The diameter of the flywheel is 25 feet and its weight 30 tons. The foundation upon which the engine rests contains 912,000 bricks, 3,000 barrels of Portland cement, and 300 tons of granite cap stones.

The big sand wheels are 50 feet in diameter, and have a lifting capacity of 30,000,000 gallons of water each and 3,000 tons of sand every twenty-four hours.

The sand from the mill carried out into the lake by a system of launders has made hundreds of acres of artificial peninsulas, while the lake itself, once a beautiful blue, is now dyed to a deep pink from the effects of the red conglomerate. The yield of refined copper at the Calumet and Hecla mine to cubic fathom of ground broken, is 850 pounds; yield of mineral per cubic fathom of ground broken, 1,130 pounds; yield of refined copper per ton of rock stamped, 52·78 pounds; percentage of copper in stamp rock, 75 pounds average.

During 1895 the Calumet and Hecla mill treated on an average 4,000 tons of rock per day, which yielded an average of 5,000 tons of mineral per month.

A conception cannot easily be formed of the tremendous displacement that is going on underground in this mine. Imagine a great trench two miles long,



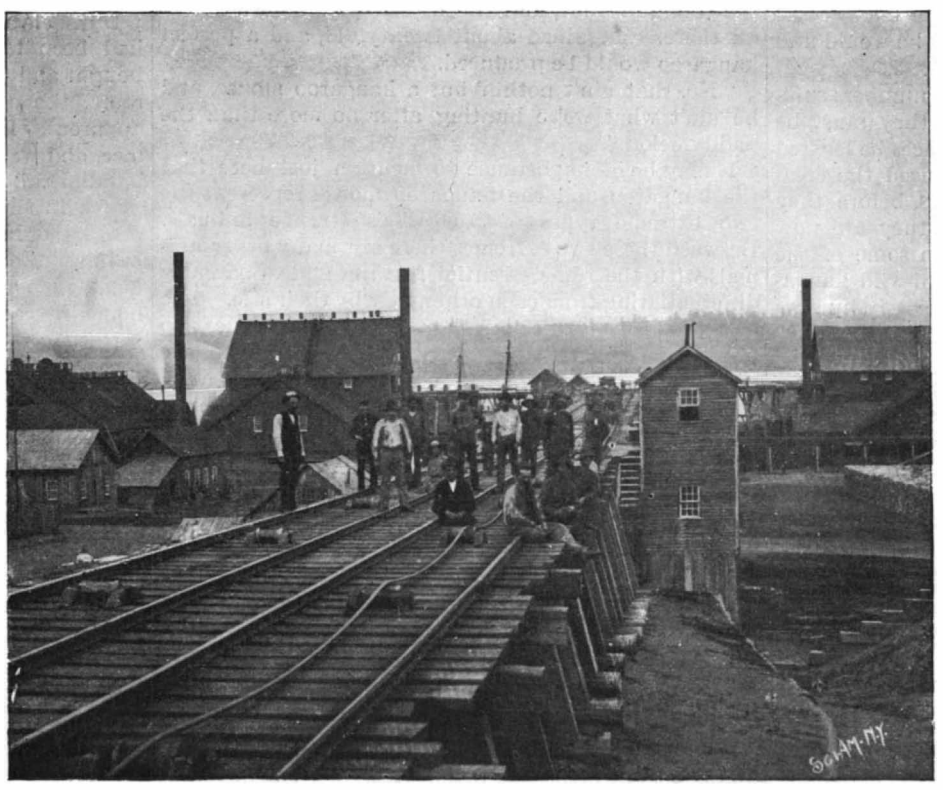
ORE DOCKS OF THE CALUMET AND HECLA MINE.

twenty feet wide and one hundred feet deep, and you may form some idea of the openings which the annual product necessitates.

Many persons will wonder how long the mine can last with such a great production. But when they are told that the mine is at present, opened up thirteen years in advance of the stoping, they will cease to wonder. Besides this, they have territory as yet untouched which insures thirty years more at the present rate of production.

The Red Jacket shaft of the Calumet and Hecla copper mine is the deepest in the world. Imagine a great hole measuring 14 × 22½ feet inside the timbers, penetrating into the bowels of the earth, straight as an arrow, for 4,900 feet. This shade which has a capacity of four times that of the old shafts, is constructed after the following manner:

The first cross cut which connects the shaft is at a depth of 2,106 feet, has a length of 1,553 feet, and intersects No. 4 shaft at the 36th level. The second cross cut, at a depth of 2,290 feet, intersects the "lode" at the 39th level, while the third cross cut intersects it again at the 42d level, at a depth of 2,463 feet. From the latter intersection the levels range 90 feet apart, and afford access to all parts of the mine. Each level has three openings at the shaft proper, which is the main entrance, while on the northwest and south sides the



CALUMET AND HECLA STAMP MILLS.

openings are made with a curve until they reach the main drift, at a distance of 175 feet from the shaft proper.

The largest number of feet sunk in any one month was 69½, and in one week 17¾ feet, and the least number in a week was 12 feet. The cost of sinking averaged $25.70 per foot.

The hoisting plant at the Calumet and Hecla mine is probably the largest and most powerful of its kind in the world. The great Superior engine which operates the hoisting drums at the Calumet branch develops 4,500 horse power. The shaft of this engine is of steel, 16 inches in diameter, and the balance wheels, of which there are two, are 33 feet in diameter and weigh 40 tons each The engine is run to a speed of 55 revolutions per minute.

The other hoisting engines, of which there are ten, have a horse power of 2,000 to 3,500 each. Five of these are of the triple expansion patterns, and are monuments to the master genius Leavitt.

The hoisting drums, around which the wire rope attached to the skips coils itself, are 30 feet in diameter. Electric indicators and bells tell the engineer when to start and stop the motion of the drum. At the Red Jacket shaft of this mine an endless wire rope measuring 9,800 feet conveys the skips loaded with copper to the surface.

From observations taken by the writer in the Calumet mine, it is found that the temperature increases only one degree in every 250 or 300 feet of descent, and the increase is barely noticeable in the bottom of the mine, except in some shafts, and even then is not oppressive, as is claimed.

The exact temperature at the bottom of the Red Jacket shaft when the drilling machines are working is 78 degrees, and when the machines are shut down, and have remained so for some time, the temperature does not exceed 81 degrees.

True, there are places in the Calumet and Hecla mines where the thermometer registers 105 degrees, and even 108 degrees, but this is in the pump rooms at the eighth, sixteenth, twenty-fourth and thirty-third levels of Nos. 4 and 5 shafts, and this excessive heat is caused not by the internal heat of the earth, but by the big four inch steam pipe which carries the steam from the boiler house on the surface to the various pumps underground, even to the very last one on the line, 3,300 feet below the surface.

A fact to which some will hardly give credence is that the temperature in these mines is lower in summer than in the winter time.

Fruit as Medicine.

Why for ages have people eaten apple sauce with their roast goose and sucking pig? Simply because the acids and peptones in the fruit assist in digesting the fats so abundant in this kind of food. For the same reason at the end of a heavy dinner we eat our cooked fruits, and when we want their digestive action even more developed we take them after dinner in their natural uncooked state at dessert. In the past ages instinct has taught men to do this; to-day science tells them why they did it, and this same science tells us that fruit should be eaten as an aid to digestion of other foods much more than it is now. Cultivated fruits, such as apples, pears, cherries, strawberries, grapes, etc., contain on analysis very similar proportions of the same ingredients, which are about one per cent of malic and other acids, and one per cent of flesh-forming albuminoids, with over 80 per cent of water. Digestion depends upon the action of pepsin in the stomach. Fats are digested by these acids and the bile from the liver. Now, the acids and peptones in fruit peculiarly assist the acids of the stomach. Only lately even royalty has been taking lemon juice in tea instead of sugar, and lemon juice has been prescribed largely by physicians to help weak digestion, simply because these acids exist very abundantly in the lemon.—Pop. Sci. Monthly.

The X Rays in a Patent Suit.

In an action for infringement recently tried in England, the plaintiff submitted as an exhibit a "shadowgraph" of a box made with the Roentgen rays, to show that certain fasteners made by the defendants had the same function as those covered by the plaintiff's patent. —Illustrated Official Journal.

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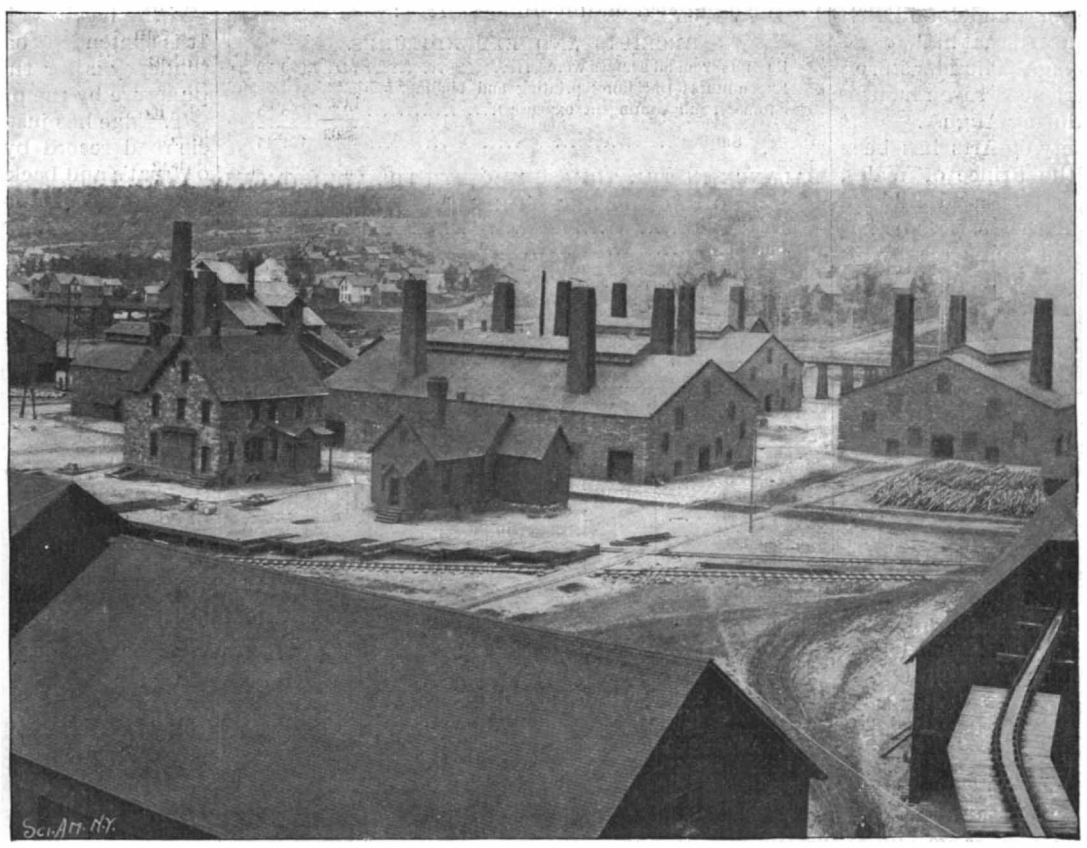
Refining Silver by Electrolysis.

The electrolytic method for refining silver, which was devised by Mobius some time ago, appears to be in successful operation now at the works of the Pennsylvania Lead Company and elsewhere. The process is distinctly interesting on account of the new features which it involves. The silver to be refined is first treated by ordinary well known metallurgical processes to reduce the quantity of other metals present (lead, copper, bismuth, etc.) to at most 2 per cent. It is then cast in sheets measuring 45 × 25 × 1·3 cm. and weighing 13—15 kilos. each. These serve as anodes. The cathodes are formed of thin, rolled sheets of pure silver, 33 × 55 × 2 cm. in size. The electrolyte is a solution of the nitrate of copper and silver, to which 0·5 —1 per cent of nitric acid is added to prevent the deposition of the copper. Four cathodes and three anodes are placed in each cell at distances apart severally of 43 mm. The anodes are inclosed in muslin bags for the purpose of intercepting the undissolved matters which fall from them as the action proceeds. These consist of gold, bismuth, the principal portion of the lead (in the form of dioxide), and a little silver and copper. A sheet of woolen cloth stretched on a frame near the bottom of each cell catches the silver as it is removed from the cathodes by a mechanically moved wooden scraper. The intensity of the current employed is 18 amperes per square foot of cathode surface. The silver is collected from each cell at intervals of two days, the gold once a week. The silver is washed with water and then melted in graphite retorts capable of holding 560 kilos. each, and is thus obtained of a fineness of 999—999·5. The residue of gold, etc., after being melted, granulated and treated with acid, gives gold of a fineness of 996—998. In the above process, care must be taken that the amount of copper in the electrolyte does not exceed 4-5 per cent, as otherwise the silver is not obtained in a pure state —The Electrical Review.



CALUMET AND HECLA SMELTING WORKS.

THE PROVIDENCE HORSELESS CARRIAGE RACE.

In the last issue of the SCIENTIFIC AMERICAN we gave an account of the first two heats run on the Narragansett Park track at Providence, R. I. Owing to a severe storm which swept New England during the race week, the plans of the managers were upset and only one more heat was run, the winners being Morris & Salom; the Riker carriage was only a few yards behind.

The fastest mile was made by the Riker electric carriage, the time being 2:13. The Morris & Salom electric carriage made the fastest five miles, covering the distance in 11:27. The prize money was reduced on account of the five heats not being run. The first prize, of $900, was adjudged to the Riker Electric Motor Company, of Brooklyn, N. Y.; the second prize, of $450, to Morris & Salom, of Philadelphia, Pa. The contestants were anxious to run the other heats, in spite of the weather, but the management declined. The announcement of the success of the electric carriages created some surprise, as it has been thought lately that motors using some form of petroleum were best adapted for horseless carriage use, and the electric motor has been somewhat discounted. The electric carriage has made a record for speed, and the great ease of control and the absence of noise and odor will commend it to those who are anxious to purchase horseless carriages, but whether they are adapted for long runs or not still remains to be proved.

The entries were as follows (but in one case several carriages of the same make were entered under different names): Duryea Motor Wagon Company, Springfield, Mass.; Morris & Salom, Philadelphia, Pa.; W. Lee Couch, New Brighton, Pa.; Lewis Brown, Sawkill, N. Y.; J. Frank Duryea, Springfield, Mass.; George H. Hewitt, Springfield, Mass.; C. Mayhew & Son, Saratoga Springs, N. Y.; Riker Electric Motor Company, Brooklyn, N. Y., P. F. Olds & Son, Lansing, Mich.; and Fiske Warren & Company.

Great interest was manifested in the races, which were witnessed by 5,000 spectators. Our engraving shows the carriages lined up for the start.

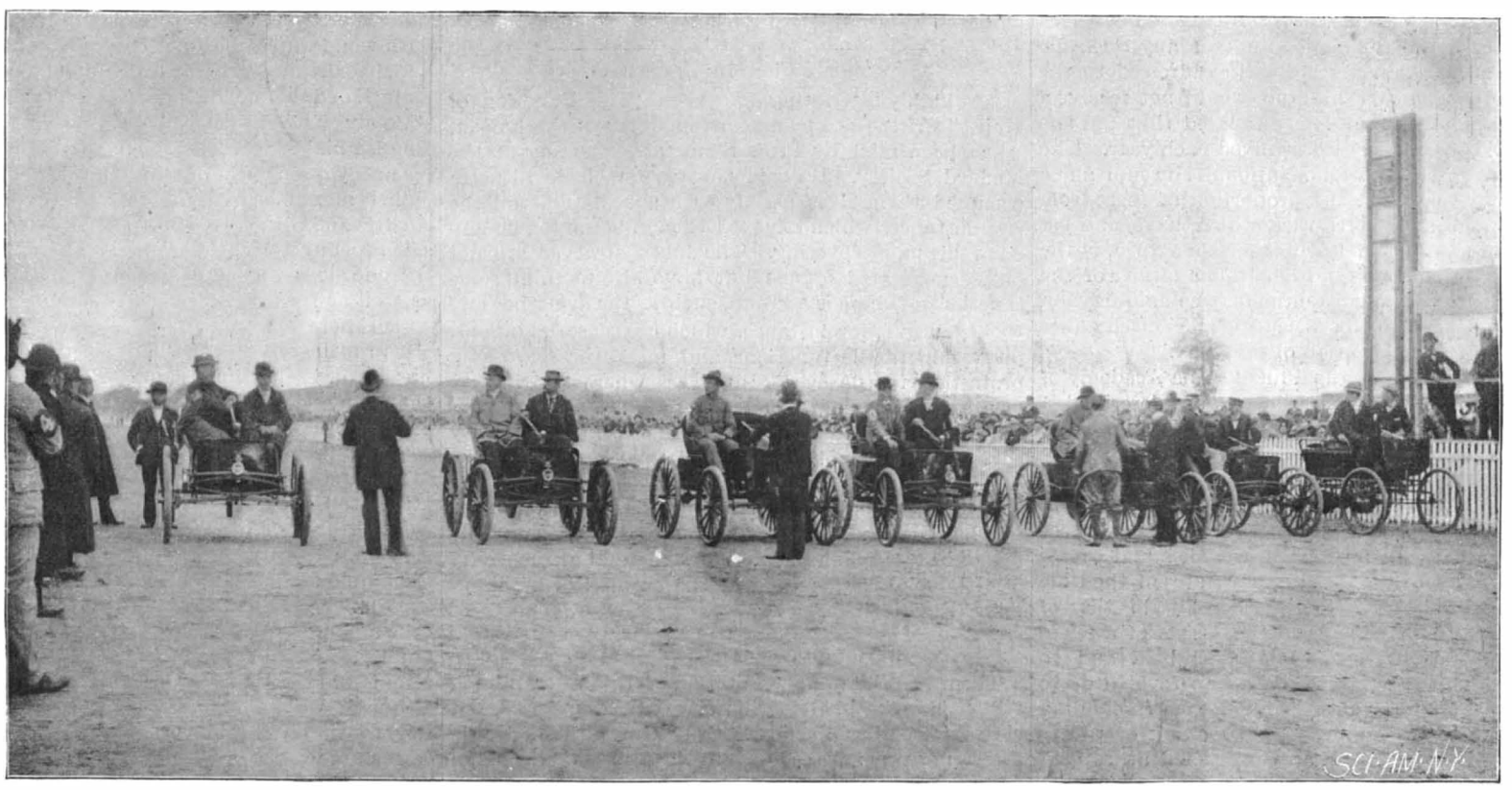
Electric Farming.

The agricultural department of the Cornell University recently published the results of some experiments extending over a period of six years, upon the effect of the light of the electric arc lamp upon the growth of plants. There were two houses, both of which were exposed to sunlight during the day, and one of which received in addition the light from an arc lamp during a part of the night. The arc lamps were inclosed in clear glass globes. It has been observed that the effects of the light of one inclosed in a glass globe are markedly different, the former in some cases proving injurious instead of beneficial to the plants. It was found as a result of these experiments that there was a decided beneficial influence on the growth of lettuce, and that there can no longer be any doubt as to its advantages in forcing this plant. With seed sown under ordinary conditions, and the young plants placed under the influence of the light after they are well established, will show marked improvements up to a distance of forty feet. One curious thing was noticed, that the effect of the shadow of a beam or rafter cast by the electric light showed plainly on the leaves. It is stated in this report that Mr. Rawson, a fancy truck farmer near Boston, now uses the electric light in the commercial forcing of lettuce. He has three lamps of 2,000 candle power each, which run all night. The hothouse covers nearly one-third of an acre. Mr. Rawson finds that he obtains a gain of five days per crop during the winter, which makes a gain of three weeks for the three crops during the winter. The gain from one crop, he estimates, is sufficient to pay the expenses of operating the electric lights during the whole season.

Prof. Bailey's experiments at Cornell confirm those of Mr. Rawson, as he states he finds many plants grow more rapidly when under the influence of the electric light at night. Among these are the daisy and the violet. He is convinced, he says, that the light can be used in forcing certain plants.

X Ray Experiments in Japan.

We have received from Y. Yamaguchi and T. Mizuno, professors of physics, Daüchi Kōtō Gakkō, Tokio, Japan, an interesting pamphlet containing numerous excellent half-tone reproductions of good X ray photographs. The text is entirely in Japanese, but the pictures speak for themselves, and indicate a high degree of skill of the Japanese investigators in this new branch of physics.



THE PROVIDENCE HORSELESS CARRIAGE RACE—THE START.

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Science Notes.

At a recent meeting of the Royal Meteorological Society a paper was read on "Arctic Hail and Thunder Storms," in which the author, Mr. H. Harries, stated that the commonly accepted opinion that hail and thunder storms are unknown in the Arctic regions is entirely incorrect. He examined one hundred logs of vessels which have visited the Arctic regions, and found that out of this number seventy-three showed that hail was experienced some time during the voyage. Thunder storms were less frequent, but were experienced seven months of the year, being most frequent during August.

The Albert Medal of the Society of Arts has been awarded, with the approval of the Prince of Wales, the president of the society, to Prof. David Edward Hughes, F.R.S., "in recognition of the services he has rendered to arts, manufactures, and commerce by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone." The council of the society have awarded silver medals to the following readers of mechanical and scientific papers during the session 1895-96: W. J. Dibdin, for his paper on "Standards of Light;" A. A. Campbell Swinton, for his paper on "Roentgen's Photography of the Invisible;" E. W. Moir, M.I.C.E., for his paper on "Tunneling by Compressed Air;" and George Simonds for his paper on "Bronze Casting in Europe."

"Observations have been made by Prof. Lloyd Morgan on instinct in young birds," says Appleton's Popular Science Monthly, "with a view to determine how far the activities involved in swimming, diving, running, flying, feeding, bathing, etc., are instinctive or congenital, and how far the definiteness of this and other activities is a matter of individual acquisition. Other observations were on congenital and acquired timidity. They indicated that while the performance of the activities in question has a congenital basis, they are perfected by individual acquisition, and that there is no instinctive avoidance of insects with warning colors, this seeming to be entirely the result of individual experience. No material support was afforded to the view that the instinctive activities result from the inheritance of what is individually acquired."

Huxley's table on the "Chemical composition of man of the average weight of 154 pounds" was for years the standard, but it has recently been superseded by a new one compiled by the Paris Academy of Sciences, says the Mining and Scientific Press. The table is appended:

Elements.	Pounds.	Ounces.	Grains.
Oxygen	111	8	0
Hydrogen	21	6	0
Carbon	21	0	0
Nitrogen	3	10	0
Phosphorus	1	2	88
Calcium	2	0	0
Sulphur	0	0	219
Chlorine	0	2	47
Sodium (salt)	0	2	116
Iron	0	0	100
Potassium	0	0	290
Magnesium	0	0	12
Silica	0	0	2

The late Dr. Brown Goode made the following comparison in a report of the United States National Museum: "There is not a department of the British government to which a citizen has a right to apply for information upon a scientific question. This seems hard to believe, for I cannot think of any scientific subject regarding which a letter, if addressed to the scientific bureaus in Washington, would not receive a full and practical reply. It is estimated that not less than 20,000 such letters are received each year. The Smithsonian Institution and National Museum alone receive about 6,000, and the proportion of these from the new States and Territories, which have not yet developed institutions of learning of their own, is the largest. An intelligent question from a farmer of the frontier receives as much attention as a communication from a royal academy of sciences, and often takes more time for the preparation of the reply."

At a recent meeting of the Philadelphia Academy of Natural Sciences, Dr. Charles S. Dolley described a centrifugal apparatus, which he called a planktonokrit, for the quantitative determination of the food supply of oysters and other aquatic animals. By means of its use he is enabled to make a large number of plankton estimates in a day, and thus judge of the characters of given areas of water in connection with fish and oyster culture at different times of the day, states of the tide, varying depths, etc. The method employed is that of the centrifuge, an apparatus which consists of a series of geared wheels driven by hand or belt, and so arranged as to cause an upright shaft to revolve up to a speed of 8,000 revolutions per minute, corresponding to 50 revolutions per minute of the crank or pulley wheel. To this upright shaft is fastened an attach ment by means of which two funnel-shaped receptacles of one liter capacity each may be secured and made to revolve with the shaft. The main portion of each of these receptacles is constructed of spun copper, tinned. When caused to revolve for one or two minutes, the entire contents of suspended matter in the contained water is thrown to the bottom of tubes properly placed, from which the amount may be read off by means of a graduated scale.

Annual Report of the Commissioner of Patents for the Fiscal Year 1895-96.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE,
WASHINGTON, D. C., September 5, 1896.

SIR: I have the honor to submit the following report of the business of the United States Patent Office for the fiscal year ending June 30, 1896:

RECEIPTS AND EXPENDITURES.

Receipts from all sources were	$1,307,090 30
Expenditures (including printing and binding, stationery, and contingent expenses)	1,097,368 85
Surplus	$209,721 45

BALANCE IN THE TREASURY OF THE UNITED STATES ON ACCOUNT OF THE PATENT FUND.

June 30, 1895	$4,566,757 73
June 30, 1896	209,721 45
Total	$4,776,479 18
Number of applications awaiting action on the part of the office on July 1, 1896	8,943

COMPARATIVE STATEMENT.

Date.	Receipts.	Expenditures.
June 30, 1890	$1,347,203 21	$1,081,173 56
June 30, 1891	1,302,794 59	1,145,502 90
June 30, 1892	1,268,727 35	1,114,134 23
June 30, 1893	1,288,809 07	1,111,444 22
June 30, 1894	1,183,523 18	1,053,982 38
June 30, 1895	1,195,557 07	1,038,166 08
June 30, 1896	1,307,090 30	1,097,368 85

Date.	Applications for Patents, Including Reissues, Designs, Trade Marks, Labels, and Prints.	Applications Awaiting Action on the Part of the Office.
June 30, 1890	43,810	6,585
June 30, 1891	43,616	8,911
June 30, 1892	43,544	9,447
June 30, 1893	43,589	8,283
June 30, 1894	39,206	7,076
June 30, 1895	41,014	4,927
June 30, 1896	45,645	8,943

Summarizing these tables, there were received in the fiscal year ending June 30, 1896, 41,660 applications for patents, 1,641 applications for designs, 84 applications for reissues, 2,460 caveats, 2,064 applications for trade marks, and 171 applications for labels. There were 22,791 patents granted, including reissues and designs; 1,782 trade marks registered, and 11 prints registered. The number of patents which expired was 11,466. The number of allowed applications which were by operation of law forfeited for nonpayment of the final fees was 4,014. The total receipts were $1,307,090.30; the receipts over expendituesr were $209,721.45; and the total receipts over expenditures to the credit of the Patent Office in the Treasury of the United States amount to $4,776,479.18.

CURRENT WORK.

On the 30th of June, 1896, all but four of the examiners had their work within one month of date, two were between one and two months, and the other two were between two and three months from date. At the close of the fiscal year there were 8,943 applications awaiting action on the part of the office. Very respectfully, your obedient servant. JOHN S. SEYMOUR,

The Secretary of the Interior. Commissioner.

The Function of Hair.

"A highly interesting paper on 'The Function of Hair,'" writes the Vienna correspondent of the Lancet, "has been read by Prof. Exner at a meeting of the Medical Society. He said that writers have hitherto occupied themselves mainly with speculations on the circumstances which have led to man becoming denuded of his hairy covering. The hairs, however, are not only degenerated organs, but have also to fulfill some functions. There is a group, such as the eyelashes and the eyebrows, for instance, which are sensorial organs, possessing tactile functions, and, moreover, serve as a protection to the eyes. In places where two integumentary surfaces are in contact . . . they act as rollers and facilitate the gliding of the integumentary surfaces on each other. A third function of the hairs consists in the equalization of surface temperature. There is no doubt that the hair of the scalp protects the head against external cold and also prevents the loss of heat through the very low thermal conductivity of the hair cylinders and of the cushion of air intermingled with them."

National Academy of Design.

The fifteenth annual exhibition of this veteran institution is to be held in this city on November 23, and closes December 19, next. Only the work of living artists not previously shown in New York or Brooklyn will be on exhibition.

In connection with the academy is the Department of Schools, beginning October 5, 1896, and ending May 15, 1897, where several branches of art are taught by some of the best artists. The president is Thomas W. Wood, and the secretary J. Carroll Beckwith. Of the artists on the council may be mentioned such names as Walter Shirlaw, J. G. Brown, Frederick Dielman and F. S. Church.

Cycle Notes.

Prof. Roentgen, the discoverer of the X rays, is a cyclist.

A French peasant has made a wooden bicycle in which even the nails are made of wood.

One of the largest bicycle concerns in the United States will adopt the chainless wheel for an 1897 model.

A tire has been invented in which feathers are used. It is contended that when a puncture occurs, the first tendency is for the down to be carried up into the puncture by the pressure of the air on the inside.

T. Edge has just broken the English 1,000 mile bicycle road record by traveling from Land's End to John o'Groat's and back to Forfar in four days nine hours and nineteen minutes. This is fourteen hours better than the previous record.

Part of the Paris horse market has been set aside for a public bicycle market, which will be held once a week. The track used to show off the horses will also be used for the trial of the machines. All bicycles sold in the market will pay a tax of ten cents to the city.

Consular Agent Mertens, at the port of Valencia, Spain, reports to the Department of State that the ladies of Spain are taking up bicycling, and he thinks this will help in removing that barrier which prevents them from going out unless attended by some responsible duenna. American wheels are unknown in Spain, though an inferior French machine called "L'Americaine" and bearing a spread eagle with the United States coat of arms is extensively advertised. There is said to be a good chance for our wheels in Spain, as Germany is barred out by tariff discriminations and the French and English wheels are unsatisfactory.

The bicycle track in Moscow is one of the best in Europe, says the Bicycling World. It is one of the most modern things about the old Russian capital, and is situated on the plain of Hodinsky, where the recent great loss of life occurred. The track is 600 meters, less than three laps to the mile, all of cement, with steep banking at the turns, and a system of electric timing which, indifferently successful at Paris, works like a charm in Moscow. There are more than 4,000 cyclists in the city and two large clubs. The development of cycling in Russia is wonderful, considering that the roads are horrible—rutty, stony, hilly, and frequently covered with the miserable pave, that despair of European wheelmen.

There is evidence to show that the ball bearing was invented at the works of Messrs. Boulton & Watt somewhere about the year 1760. Its inventor was John Wyatt, a native of Weeford, near Lichfield. Wyatt, it is said, tried hard to solve the problem of cutting files by machinery, but failed. He was more successful with a spinning machine, in which some claim he anticipated Arkwright and Hargreaves, and even more successful with a compound lever weighing machine. Lack of capital led to financial embarrassment, and drove him to Boulton & Watt's shops, which were then a kind of refuge for inventors in distress. It was there he devised the ball bearing. For more than a century the ball bearing was practically neglected. A short pamphlet narrating Wyatt's achievements was published by Hamilton, Adams & Company in 1885.

In the last British consular report from Venice it is said that cycling has spread through the province with wonderful rapidity. The wide and smooth roads which exist in North Italy and which are carefully maintained in a good condition at the expense of the state are covered with cyclists. Bicycles and tricycles of English make are considered the best, and would be naturally preferred, but for the lower prices of machines manufactured in Italy, or those coming from Austria and Germany. Most people prefer, for economy's sake, to buy the cheaper ones. There would be a field there for low, very light machines at a moderate price, as well as for practical cycle boats or water cycles, of which there are none in use so far. There are no cycles propelled by steam, oil, or electricity, and no horseless carriages in the district. The vice consul thinks that there will be an opening for the sale of machines, and also in establishing lines for the conveyance of parcels and passengers in horseless wagons and carriages.

The nuisance of the gongs which youthful wheelmen attach to their mounts has been referred to in the New York Tribune. A device which has been suggested, if it has not already been adopted by noise loving riders, is a chime of bells, of harmonious tones. If the thing goes much further, the board of health will have to take a hand to protect the nerves of a suffering community. A noise-producing arrangement which is common in some parts of Connecticut and elsewhere, although wholly or comparatively unknown in this city, consists of strips of rubber passed around the diamond frame of a bicycle. The ordinary bands can be used if the front wheel is removed so that they can be put on, or a long strip of rubber, wound around and around, will serve. The strips must be stretched as tight as possible. In a wind the rubber acts as an Æolian harp, giving forth a sound not entirely unmusical. Sometimes it resembles the buzzing of an approaching trolley car, and is a great mystery to those unfamiliar with it, especially if there are no street railway tracks in sight.

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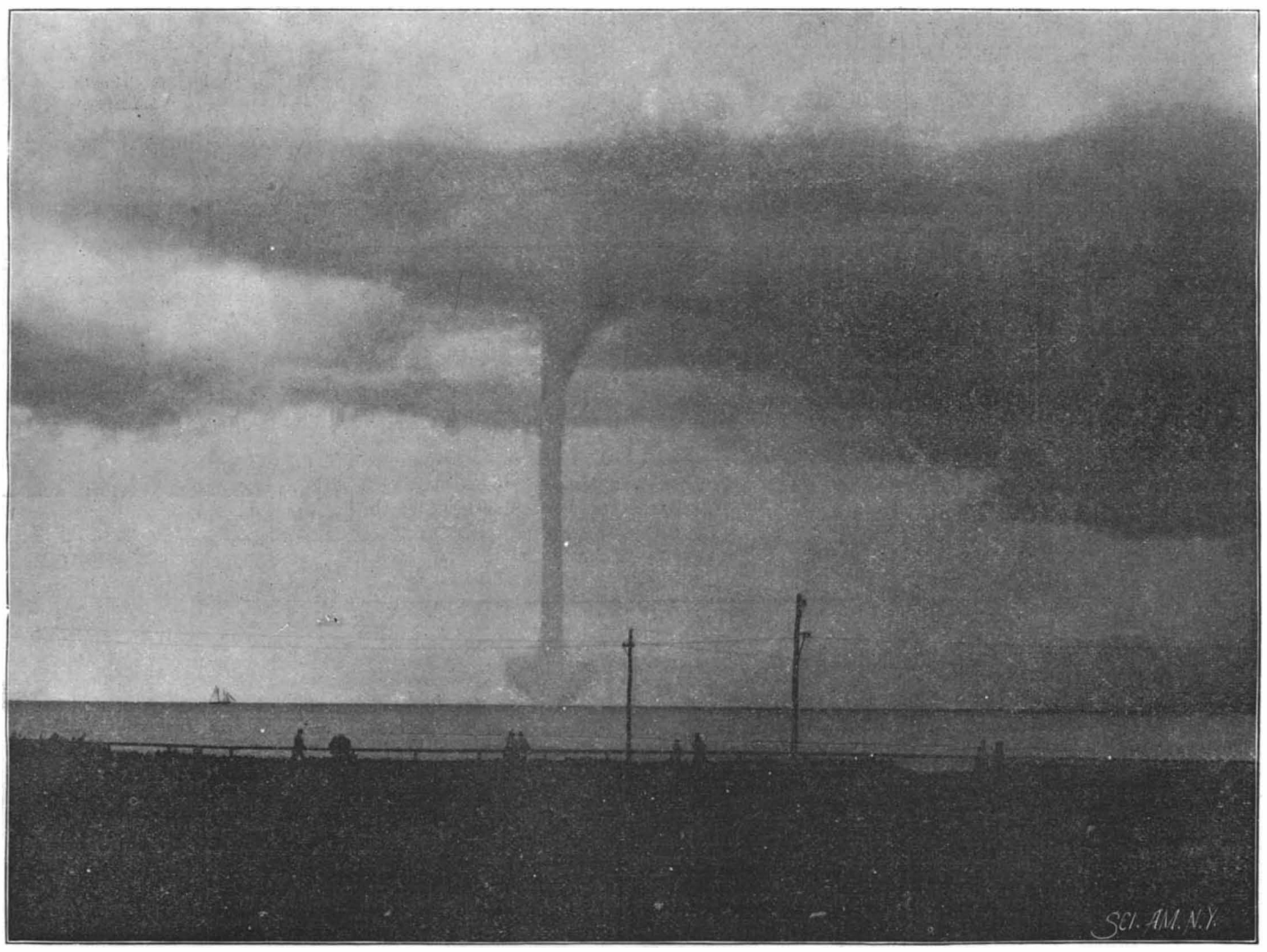
WATERSPOUT OFF COTTAGE CITY, MARTHA'S VINEYARD.

BY DR. F. C. V. H. VOM SAAL.

About 12:30 noon, August 19, 1896, one of the very dark clouds hovering over Vineyard Sound, between the mainland and Cottage City, was seen to send out a downward and sharply pointed streak of cloud matter, whose funnel-shaped basis above was not at all times visible. After a duration of about 15 minutes it broke and completely vanished. The apparition quickly emptied of their summer residents all the cottages along the Sound and adjacent islands, Nantucket included. No photographs were taken of this first spout, to my knowledge.

Shortly afterward a long tongue emanated from the same clouds, and was slowly pushed downward to a point about 100 feet from the surface of the ocean. Its height was certainly a mile, and the band-like shape gradually increased in width. With a glass, slow gyratory movements could be detected, also longitudinal stripes caused by falling water. This cloudburst made the water below, over a surface of many hundred yards, look like a boiling pool. The jumping spray from this was also caught and drawn upward into the whirl toward the downpouring column. This latter, now of lighter color being struck by the sun, was gradually withdrawn upward, evidently thinning and broadening toward its base. With a glass, falling mists could be still seen falling into the snow-white foaming area below. The duration of this second and most perfect phenomenon of the day—there were three in all—was about half an hour.

About twenty minutes after its disappearance a third began to form, gradually coming downward from the same clouds, though from a spot a little farther north; but it hardly reached completion. It is very important to note that, in this third case, the ocean below was entirely quiet for a time, being only disturbed later on, when the same process of condensation mentioned above caused a similar downpouring, especially noticeable in the period of retraction. It was soon apparent that the agency causing the spouts had spent its energy; the column was evidently thinner in substance and its formation slower and hesitating. It stopped midway, sending only an attenuated end further, to be withdrawn upward soon after.



WATERSPOUT OFF COTTAGE CITY, MARTHA'S VINEYARD.

During almost all of the time since the appearance of the first spout there was a heavy rain storm accompanied by flashes of lightning from the northern and darkest portion of the long motionless stratum of clouds above mentioned.

Cottage City, which had been in sunshine until then, was visited by a drenching rain some hours later.

The long duration of the phenomena just described enabled the writer to form a somewhat different opinion of the nature of such waterspouts from what is commonly held. True, I must fall back upon the old (or rather older) explanation that such whirls are caused by two winds striking each other at an obtuse angle. The greatest rotary velocity must be placed at the spot, about one hundred feet above the ocean, toward which the cloud matter from above and the spray from below were drawn. As condensation was continually transforming this cloud matter into water, it stands to reason that by far greater quantities of it were drawn down than was apparent to the eye.

But the spout is from above and not from below, as a glance at the cut conclusively proves. This also definitely settles the question as to what part the ocean takes in the constitution of the column; which is practically none. The "boiling as if in a caldron" is not caused by the action of the circling wind, but by the great quantities of falling water. Nor is there a whirlpool action in, nor a rising from, the body proper of the ocean. The way the spray, caught and drawn up, looked at times easily explained to me how this delusion originated.

The surprising tranquillity of the clouds shows that such currents of wind need not be of great height, at least not at their borders, where alone such whirls can take place. That the spouts scarcely shifted their position is proof that the velocity of the concurrent winds was almost equal. It is certain that this velocity cannot have been great. Several small vessels in close proximity at the time report that there was a great noise and gusts of wind in the immediate vicinity of the display, while beyond this there was almost a dead calm (Boston Globe, September 1). This latter statement, however, seems to be somewhat exaggerated.

The attitude of the public was almost as interesting an object for observation as the waterspouts themselves. That they would create intense excitement, expressed in various ways, as all unusual occurrences like comets, meteors, eclipses, earthquakes, etc., are apt to do, was natural. Not so easily to be explained are the accounts which some entirely honest people gave afterward in good faith. Positively astonishing were the wonders they had seen with their own eyes, and even more astonishing was the exaggeration which prompted the description. One can now better understand the origin of many of the natural wonders which are from time to time recorded, and that they are not always the product of diseased or hysterical minds.

The Electric Furnace for Iron and Steel.

In the blast furnace method of reducing iron the metal takes up impurities such as sulphur and silicon, and these are entirely removed in subsequent treatment by the Bessemer or Martin process. The present methods of smelting must hold the field for ordinary grades of iron; but when purity is of importance, and when special qualities of steel are required, it will probably prove advantageous to prepare pure iron by electrical methods of reduction, and to carbonize this subsequently. A furnace suitable for this and similar purposes is described by R. Urbanitzky in the Zeitschrift fur Elektrochemie, vide vol. ii, page 350. It is lined with a basic lining, like a Bessemer converter; this is non-conducting and almost infusible, and keeps the iron free from impurities. In the Heroult furnace used at Neuhausen, the positive carbon is vertical, and the material to be used has to be introduced into the narrow space between this and the walls of the furnace. It is preferable to have a positive electrode, consisting of four carbons arranged symmetrically about a vertical axis, and inclined at about 20° to it. These can be raised so as to produce an electric arc, or lowered, so as to dip into the fused mass; they can also be rotated backward and forward, so as to form a uniform distribution of the heat. The bottom of the furnace is insulated, and forms the negative electrode; it may either be formed of carbon, or of metal cooled by a powerful air current. Estimates of the probable working expense are given in the original paper.—The Electrical Review.

Globe Statistics.

A new computation of the population of the globe has recently been made by the French statistician and savant P. D'Amfreville, says the Literary Digest. He figured out a total of about 1,480,000,000, distributed as follows: Asia, with 825,954,000; Europe, with 357,379,000; Africa, with 163,933,000; America, with 121,713,000; Oceanica and the Polar regions, with 7,500,400; Australia, with 3,230,000; or a grand total of 1,479,729,000 souls.

In connection with these data the English statistician Schooling makes some interesting comments. He states that of every 1,000 inhabitants of the globe, 558 live in Asia, 242 in Europe, 111 in Africa, 82 in America, 5 in Oceanica and the Polar regions, and only 2 in Australia. It then appears that Asia contains more than one-half of the total population of the earth, and Europe nearly one-fourth. Africa contains only one-ninth, and America only one-twelfth. In Australia the entire population is less than the number of inhabitants in the city of London alone or in the cities of Paris and St. Petersburg combined.

In Europe the number of inhabitants to the square mile is 95, in Asia it is 48, in Africa it is 15, in America it is 8, in Oceanica and the Polar regions it is 3, in Australia only 1. Accordingly, Europe contains for each of its inhabitants 2·8 hectares of land; Asia, 5·2 hectares; Africa, 17·6 hectares; Oceanica and the Polar regions, 84·0 hectares; America, 31·2 hectares; Australia, 235·6 hectares. [A hectare is equal to 2·741 acres.] The yearly increase of population on the globe is about 5 to every 1,000. At this ratio the population of the earth would be doubled every 139 years.

Of every 1,000 Europeans, 262 are subjects of Russia, 139 of Germany, 116 are Austro-Hungarians, 107 French, 106 English, 84 Italians, 48 Spanish, 17 Belgians, and 121 of the minor countries.

In reference to the density of population, Belgium takes the lead with 546 to a square mile, followed by England with 312, Italy with 263, Germany with 237, France with 184, Austro-Hungary with 171, Spain with 90, Russia with 49. The average of all the other countries is 47 to a square mile, and the average for all Europe is 96.

In Asia the 826,000,000 are distributed in the following manner: China takes the lead with 350 millions, British India with 278 millions, Japan with 40, East Indian Islands with 39½, French possessions in India with 19, Corea with 10½, English Burma with 7½, Persia with 7½, Asiatic Russia and Turkestan with 7½, Siberia with 4½, Afghanistan with 4, Ceylon with 3, Arabia with 2½, all other parts of Asia with 43½ millions.

Of every 1,000 Asiatics, 424 are Chinese, 337 are Hindus (subjects of England), 48 are Japanese, 48 are Indian Islanders, including 23 in the French possessions, 13 are Coreans, 11 are Siamese, 9 are Burmans, 9 are Persians, 9 are Russians, 5 are Siberians, 5 are Afghans, 4 are Singhalese, 3 are Arabs, and 52 belong to smaller nationalities.

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Bullets Swerved by Electricity.

A curious phenomenon was recently observed by the committee of the Swiss Federal Rifle Meeting at Winterthur in summing up the results of the practice shooting of the troops. It was found that nearly all the shots fired from the right side of the range had hit the target to the right of the bull's eye, while those fired from the left side had, with an equally singular persistency, hit the left half of the target. The great number of men who took part in the shooting precluded the idea that this singular result could have been due to the personal peculiarities of the soldiers; for while it may be true that one marksman habitually shoots too high, another too low or to the right or left of the mark, with a large number of individuals firing at the same target, these idiosyncrasies of marksmanship would be set off one against the other and the misses would be fairly distributed on all sides of the bull's eye. It became necessary, therefore, to find an extraneous and single cause for the remarkable uniformity with which the bullets appeared to have been deflected from their proper course. The wind could not have produced the effect noted, since, in the first place, allowance had doubtless been made by the riflemen for deflection by aerial currents; and on the other hand, if the wind had diverted the missiles, the deflection would have been in the same direction on both sides of the range. An examination of the steelclad bullets extracted from the targets disclosed the fact that they had become magnetic; and this led the committee to entertain the theory that the phenomenon observed by it might have been due to electric influence exerted by the large number of telegraph and telephone wires which run along both sides of the range at Winterthur. Further experiment at the ranges of Thun and Berne proved this theory to be correct; and the remarkable discoveries made at these trials may effect another complete change in military tactics. The following account of one of the experiments is given by the Journal de Génève:

"At Thun authorities established parallel with the rifle range, at a distance of a little more that 40 yards, an electric current of 8,000 volts, carried along four steel cables. With a view of tracing the whole effect, paper circlets were placed at every 10 yards. The first experiments were made with the Swiss model rifle of 1889. With this the influence of the electric current was at once apparent. In a distance of 260 yards the bullet took a lateral deviation of 24 yards, and after that the curve of the trajectory was still more marked. The second experiments were made with the Japanese 3 3 mm. rifle of Col. Yamagata, and they were still more decisive, the bullet being rapidly attracted to the electric wires and following their course with absolute servility. Further attempts were made with artillery. The range selected was one of 3,000 yards, and 200 yards in front of the targets, but 40 yards to the side, was placed the electric battery. Every shot was diverted by its influence far to the side of the target—to be exact, the deviation was one of 14 degrees.

"The conclusions drawn from these experiments are that a section of infantry exposed to fire at 300 yards would enjoy complete safety if a dynamo or accumulator were placed on its flank; a whole company would be in the same security at 500 yards, and artillery fire could be rendered innocuous at 1,000 yards. If these facts are sound, the new small bore rifle is doomed, and we shall have to return to the heavy bullet of lead, because it is unaffected by electricity. But to military reformers this will signify a repulse along the whole line."

The facts may be as stated, but the conclusions by no means follow. We should dislike, in case of a fight, to be the man running a dynamo that had a weakness for drawing bullets to it. It would have all it wanted of them, and the attention of the commanding officer would be chiefly occupied with defending his dynamo. Besides, if skilled marksmen can allow for the deviation due to the wind, why not for the deviation due to electricity?

It would, perhaps, be premature to assert that the consequence of this discovery will be the doom of the modern small bore military rifle, with its steel jacketed bullet; for it might be practicable to inclose the leaden missile in hard bronze or some other metal not affected by magnetism. Artillery would probably remain destructive enough on the battle field by the use of explosive shells. It is in naval warfare that the discovery may have the most important consequences. In Conan Doyle's "Stark Munro Letters" the hero is credited with an invention to render a warship immune from the shots of an enemy by placing electric accumulators at its stem and stern. The idea was to deflect steel projectiles by magnetism, just like the Swiss military authorities have in fact succeeded in doing. It would certainly be a revolutionary departure if, instead of incasing our battleships in heavy bombproof armor, we could encompass them with an impalpable magnetic veil which would compel the great armor-piercing steel projectiles to pass harmlessly by.

The discovery, however, will give the military and naval experts a new problem to work out. In passing it is worthy of remark how frequently the apparently impossible feats suggested by imaginative writers have been followed by the demonstration of their possibility. Phileas Fogg's wonderful trip around the world in eighty days would to-day be a very commonplace performance; and another generation may see Stark Munro's magnetized battleship an accomplished fact. Fiction seems stranger than fact only because so small a part of the truth of science has been revealed to humanity.

Library Circulations.

Those high class weeklies that are in general demand at the public libraries throughout the country enjoy "circulations" that are often beyond the claims of their publishers or the beliefs of advertisers. It has been recently shown that, during eleven days, the six copies of Harper's Weekly were called for and read by 550 people in the Chicago Public Library. In the same period at the same place, four copies of the Youth's Companion were read by 228 individuals and two copies of the SCIENTIFIC AMERICAN by 213 people. If the public libraries of the whole country showed the same proportion of calls for these publications, it will be readily seen that their library circulation alone must run away up into the thousands.

But there is a vast number of weeklies and monthlies, too, that do not get into the public libraries, for the reason that their intellectual caliber is not high enough. This is an important item which all advertisers might wisely consider—whether a medium is of a sufficiently high standard to find place in the public libraries, because, if it is, it is sure of a much larger number of readers than if it is not.—John Chester, in Printer's Ink.

New Metals for Coins.

Advices from Washington, D. C., state that experiments with pure nickel and aluminum as substitutes for the present nickel pieces and one and two cent bronze pieces will be made at the mints by order of Director Preston during September or October. A resolution was passed by the House of Representatives authorizing such experiments. There is some doubt whether the actual adoption of a new metal for the minor coins will be recommended at an early date by the treasury officials, even if the experiments prove successful. The objection to a change in any form of coins or notes is the disposition of the public to refuse the old forms and insist upon having the new. This would drive into the mints for recoinage $14,000,000 in nickel pieces, which are now in circulation, and $7,500,000 in pennies. The advantage claimed for pure nickel, instead of the alloy now used in five cent pieces, is its greater hardness, durability and distinctness of impression.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

STREET RAILWAY SWITCH.—Hugo L. Dallig and Wladyslaw Kryszewski, Jersey City, N. J. This is a switch which may be readily set by the driver or motorman on a car, according to the direction in which the car is to travel, either along the main track rails or to the side track rails. The invention comprises a pivoted switch point on the under side of which is a segmental rack meshing with a pinion carried by a rock shaft in gear with a second rock shaft carrying two arms, while an arm pivoted on one of these arms has a head adapted to be engaged by a roller carried by the car, and the other arm is connected with a lever carrying a headed arm also adapted to be engaged by a roller carried by the car.

CAR COUPLING.—Thomas Galligan, Bradford, Ohio. This invention relates to couplings of the Janney type, in which the drawhead has a pivoted laterally movable knuckle, the coupling being automatically effected when two cars come together, and the cars being readily uncoupled from the side, without it being necessary for the trainmen to go between them. The pivoted knuckle has a hooklike latching jaw, and a spring is adapted to hold the jaw in coupled engagement. The hook nose is slotted and perforated to permit the coupling of ears with a link and pin of the old style, the link being held in connection with the coupling so it will not be lost when not in use.

CAR COUPLING.—Joseph L. Linou, Narbonne, France. According to this improvement, the coupling apparatus attached to each end of the car comprises a spring jaw placed horizontally on one side and a shackle placed vertically on the other side of the ordinary coupling, the shackles being always opposite the corresponding jaws when the cars come together. The shackles are of such depth as to allow of a certain amount of variation in the height of the car. The coupling is automatically effected as the cars come together, and the cars are readily uncoupled from either side.

Electrical.

ELECTRIC RAILROAD.—Charles Sill, New York City. This invention provides for dispensing with both the overhead conducting wires and the underground conduits which have heretofore been employed for supplying the current for electric cars, and substituting therefor a conductor placed in a longitudinal duct within the rail. A sectional trolley wire extends in a recess along the inner side of the rail, the conductor and the trolley wire being normally disconnected from each other and automatically connected as the car passes along, whereby all sections of the trolley wires are cut out and remain dead except when a car is passing over them. By the construction provided for making connection between the conductor and the trolley, complete insulation is secured and all moisture is excluded from the duct in which the conductor is located.

ADVERTISING DEVICE.—Frederick A. Ruge, Springfield, N. Y. According to this device, a series of incandescent lamps is arranged in fanciful shapes or forms to attract attention, means being provided for closing the circuits through any desired series of lamps and leaving the others cut out. By this means a certain sign may be exhibited for four or five minutes, and after this exhibition the circuit closer will be turned to close the circuit through another series of lamps showing another sign.

Mechanical.

PIPE WRENCH.—Joshua Musgrave and William Cook, Aguilar, Col. This is an improvement in wrenches which have a chain to engage around a pipe, and provides for such construction of the wrench that an equal pressure may be brought to bear on substantially the entire circumference of a pipe, obviating the danger of crushing in the pipe. The wrench jaw has a curved serrated inner surface, and on its outer end are fingers designed to be engaged by lateral shoulders on the chain links, each of which has a bifurcated portion and a stem portion, and is preferably curved on its inner edges to conform somewhat to the curvature of the pipe.

MACHINE TO HULL COFFEE BERRIES.—Afredo D'Costa Gomez, Bucaramanga, Colombia. Beneath the nopper, from which the berries drop in a stream, according to this improvement, are two rollers of unequal size revolving in opposite directions at different rates of speed, the larger roller being roughened and the smaller one smooth, a knife separator projecting upwardly between the rollers. The berries are subjected to sufficient crushing or squeezing pressure by the rollers to cause the fibrous hull to adhere to the rough surface of the larger roller, the grains going toward the small roller, and the separation being completed by the knife below.

PAPER MAKING MACHINE.—George W. Lewthwaite, Greenwich, N. Y. This invention provides yielding perforators for puncturing the felt belts for carrying wet pulp while the water is being extracted from the latter, instead of the rigidly mounted pins heretofore employed, by which the felt is torn or cut. The pins, according to this improvement, are supported in a yielding material, such as rubber, held in troughs secured in V-shaped longitudinal grooves in a roller provided for each endless felt apron over which the wet pulp is carried, whereby the pins will yield out of the felt without slitting it, and thus preserve the strength and porosity of the felt apron.

Miscellaneous.

CASH RECORDER.—David J. Wilson, Washington, D. C. This is an instrument for use by bank tellers and similar officers, the teller printing in the depositor's book the amount and date of the deposit and simultaneously printing the amount upon a record strip, there being also mechanism for calculating the aggregate upon the record strip and printing the sum at the foot. The book, on presentation, is placed in an opening in the side of the casing of the machine, where a type bar has two sets of adjustable type, strip holding devices being adjacent to one set of type, and a book clamp holding the book in position to receive the impression from the other set of type, while printing devices operate the type of both sets simultaneously.

BICYCLE RAILWAY.—William F. Mangels, Brooklyn, N. Y. This invention provides an apparatus by means of which an unskilled person can safely mount and ride around a track without incurring danger. Within a suitable building is arranged a track, preferably but little wider than the tire, and having low side guards, and adjacent to the track, at about the height of the handle bar, a continuous rail is supported by fixed standards, the top and bottom edges of the rail being adapted for engagement by grooved wheels carried by hangers on an auxiliary frame attached to the bicycle. The frame is light and readily attached to the bicycle, the latter being then securely held in vertical position on a good track, where it may be propelled with but little friction by an inexperienced rider.

PORTABLE FIRE ESCAPE.—Edward Riley, Spokane, Washington. This is a device which may be carried in a satchel or in the pocket, and consists of two metal tapes wound on a pulley having differential sections inclosed in a metal case, a combined suspension and brake device of elastic rod or wire being wound around the enlarged central portion of the pulley and extending below the case for connection with a strap, to be attached to the body of the person to be lowered. The friction device acts as a brake to prevent too rapid paying out of the tapes, and this friction may be increased by manual pressure as desired. The apparatus is very compact, a case about three inches in diameter accommodating tapes fifty feet long.

SASH LOCK AND OPERATOR.—Michael F. Robinson, New York City To raise and conveniently lock a sash to form any desired opening, for ventilation or other purposes, or to securely lock it when entirely closed, without using the ordinary weights and sash cords, this inventor has devised a construction which comprises gearing suitably located in a small casing in the side of the window casing and engaging a rack on the sash, a spring operating the gearing in connection with a locking device composed of a clutch, one member of which is connected to the gearing, while the other member is movable in and out of connection. The locking mechanism cannot be interfered with by any one from the outside.

CURTAIN FIXTURE.—Alderic F. Girouard, Leominster, Mass. This is a fixture which may be adjusted to any length of shade roller and secured upon the window casing without the aid of nails or screws. Brackets carrying adjustable slides to which the curtain fixtures may be conveniently attached are adjustably fixed in the top inner portion of the window frame by means of clamping plates which are brought into firm engagement with the inner faces of the window frame through cross rods connected by a sleeve, the rods and sleeve having a right hand interior thread at one end and a left hand thread at the other end and the ends of the sleeve sliding within an outer tube.

MUSICAL INSTRUMENT.—Francisco Barrientos, San Juan Bautista, Mexico. This invention relates to instruments played with a pick, and is designed to enable the performer to readily play in octaves, producing sounds as if he were playing two instruments. For this purpose a special construction of the instrument is provided, in which a raised stop is arranged on its body laterally of the strings to arrest the pick, the pick being double, and the performer striking the strings with it both above and below the bridge.

VEHICLE AXLE SPINDLE AND BOX.—John A. Rumrill, Salina, Kans. The axle spindle, according to this invention, has a socketed stub end and a grooved journal bearing, while the box has hollow bearings spaced by an annular chamber, the improvement rendering the box and axle spindle easy to lubricate, and also affording means for storing a supply of lubricant which automatically feeds itself while it lasts.

FARRIER'S KNIFE.—Francis M. Me Cartea, San Juan, Cal. This knife has at one end of its handle a curved knife blade secured in its socket by a thumb screw, the blade having at its end a mud scraper and a hook or pick for cleaning out the seam on the bottom of the horse's hoof, while at the other end of the handle are pivoted a bleeding knife and a searching tool. In the handle are also chambers to receive two combination tools, one consisting of a mud spoon, a lance, and a sounder or probe, and the other constituting a hoof pick, a needle and tweezers.

SUCTION DREDGE.—James H. Bacon, Wilmington, N. C. This dredge has an open bottom suction box in which swing oppositely arranged connected cutters that are automatically actuated on dragging the box along the bottom of a waterway. The box is flushed by valves in its sides actuated from the deck of the dredge, and adjustable stops limit the swinging motion of the cutters.

APPLYING PAINTS OR VARNISHES.—Howard C. Cleaver, London, England. This inventor has devised an apparatus to facilitate the application of oil paint, flatting paint and varnish with greater rapidity, uniformity, smoothness and lightness than is possible with a brush, the paint or varnish being atomized and projected in fine spray by an air blast through an exit orifice, where it is met by a blast directed across the orifice. By this means the paint or varnish is laid so lightly that a second coat may be applied as soon as the previous one becomes tacky, quickly giving a smooth surface without brush marks and dispensing with rubbing down.

WHEAT STEAMER, HEATER, ETC.—William H. Reitz, Somerset, Pa. This is a device for use with flour mills, regulating also the feed of the

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wheat to the break rolls. The flights of the conveyer are so constructed that the wheat will be carried from under the conveyer and thrown over the top to the opposite side, the grain being moistened by steam or water of condensation at a point above the conveyer, and the flights bringing the wheat in contact with the steam, while the grains are thoroughly mixed to render them all equally moist. The grains are also thoroughly warmed, the heat serving to maintain the moisture on the exterior of the grain.

CHURN OPERATING MECHANISM. — Zachariah A. Taylor, Bridgeport, Ala. For churns having a vertically movable dasher, this inventor has devised an operating mechanism consisting of a suitably mounted drive shaft geared with a countershaft whose gear carries a series of pins adapted to engage an arm on a vertically movable cross head, the pins thus raising the cross head as the gear is revolved, and the cross head, which is connected with the dasher, being quickly returned by means of springs. Owing to the regularity of the stroke, the cream is not splashed or wasted, and the butter is quickly formed. The mechanism is simple and designed to be operated by a treadle.

JAR CLAMP.—Frank H. Palmer, Brooklyn, N. Y. According to this invention a ring-shaped frame seated on the jar cover has downwardly extending arms carrying lugs adapted to engage a flange on the neck of the jar, and on the top of the frame are lugs in which is held a spring rod on which is fulcrumed a cam with a friction roller in its cam end. By means of the cam lever the clamp is readily applied, the spring rod yielding sufficiently to prevent the cracking or breaking of glass, porcelain, etc, when the cover is clamped on the jar.

SANITARY PAIL.—Charles M. D. Baron, New York City. This invention covers an improvement in the construction of a pail on which a patent was formerly granted to the same inventor, greatly lessening the cost of manufacture and providing an airtight cover for an ordinary pail, to be readily secured in place by means of the bail. The cover is light and strong, and the handle on the bail acts as a locking roller for the cover.

Designs.

GRIP FOR SKIRTS, ETC.—Ella L. Cole, New York City. To hold a belt in close engagement with a skirt or trousers, this device has one depending shank adapted to go outside the belt and another depending shank on which are twin spurs or hooks.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

ALASKA: Its History and Resources, Gold Fields, Routes, and Scenery. By Miner W. Bruce. Illustrated. New York: Frederick Warne & Company, 3 Cooper Union. Pp. 128. Cloth $1.25. Paper edition 75 cents.

Many want to know about Alaska, what the much debated country is, what is its climate, its conditions of life and different industries. This desire, the present book, with beautiful illustrations and really attractive text, will excellently supply. There is much that is practical and popular in it, such as the descriptions of the Indians, with their mode of life, with their boats, clothing, etc., all of which is in the line of the most attractive kind of anthropology. The illustrations from photographs are especially good, and say a great deal for the clear atmosphere of the country. One of Sitka, 10:30 P. M., speaking eloquently of the long Arctic twilight.

HOW TO DO BUSINESS. By Seymour Eaton, of the Drexel Institute, Philadelphia. Philadelphia: P. W. Ziegler & Company. Pages 334.

This is, in many senses, an up-to-date book, bright, original, and full of information not generally found heretofore in books of this class. Modern methods of banking and making collections; the business in negotiable papers, stocks, bonds, and other securities; insurance; importing, exporting, shipping, and warehousing; margin trading; business correspondence; short cuts in figures; doing business by telegraph, and modern bookkeeping ideas, form the subjects of some of the most important chapters. For a young man wanting to understand how business in general is conducted in the great commercial centers, this book, thoroughly mastered, affords a "short cut" to a most serviceable stock of information. Its author is Director of the Department of Industry and Finance of the Drexel Institute, and the book has questions for the subject matter of each chapter, thus adapting it for use in commercial schools and business colleges.

THE ENGINEERING INDEX. Vol. II. 1892–1895. New York: The Engineering Magazine. Pages 474. Price $4.

This volume, and the one preceding it, form a classified index to the engineering literature in the periodical press for the past eleven years. The work was begun by the Association of Engineering Societies, and is now being carried out by the Engineering Magazine, it being designed to publish an annual volume hereafter.

A MANUAL OF STEAM BOILERS. Their Design, Construction, and Operation. By Dr. R. H. Thurston, Sibley College, Cornell University. New York: John Wiley & Sons. Pages 879. Price $5.

This is the fifth edition, revised and enlarged, of a well known standard work for technical schools and engineers, designed to be a fairly complete, systematic, and scientific treatise, while yet meeting the practical wants of an engineer laying out work. Dr. Thurston is also the author of a "History of the Steam Engine," "Engine and Boiler Trials," "Materials of Engineering," and other works in this line, and for the past quarter of a century has been recognized as one of our leading authorities in mechanical engineering.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6957) W. E. K. says: Will you kindly give me a recipe for preserving cider, in your Notes and Queries? A. Professional cider makers are now using calcium sulphite (sulphite of lime), instead of mustard and sulphurous oxide gas. It is much more convenient and effectual. To use it, it is simply requisite to add ⅛ to ¼ of an ounce of the sulphite to each gallon of cider in the cask, first mixing the powder in about a quart of the cider, then pouring it back into the cask and giving the latter a thorough shaking or rolling. After standing bunged several days to allow the sulphite to exert its full action, it may be bottled off. The sulphite of lime (which should not be mistaken for the sulphate of lime) is a commercial article. It will preserve the sweetness of the cider perfectly, but unless care is taken not to add too much of it, it will impart a slight sulphurous taste to the cider. The bottles and corks used should be perfectly clean, and the corks wired down. A little cinnamon, wintergreen, or sassafras, etc., is often added to sweet cider in the bottle, together with a drachm or so of bicarbonate of soda at the moment of driving the stopper. This helps to neutralize the acids, and renders the liquid effervescent when unstoppered; but if used in excess, it may prejudicially affect the taste.

(6958) H. R. S. says: Will you please publish the receipt for making a flour paste? A. T. A. Richardson, the architect, recommends to every 2 tablespoonfuls of the best wheat flour to add a teaspoonful of common moist or brown sugar, and a few drops corrosive sublimate; the whole to be boiled, and continually stirred to prevent getting lumpy, till of the right thickness. To prevent mouldiness, a few drops of some essential oil, as lavender or peppermint.

(6959) J. C. W. says: Would you be so kind as to send me your formula for browning blue prints with tannic acid and caustic potash, which came out in your valuable paper, at your earliest possible convenience? A. Immerse the blue print after it is dried in a solution of aqua ammonia containing 22 per cent am. gas, 2 parts; distilled water, 18 parts. Leave the print in this solution from two to four minutes, or until the blue color entirely disappears, then rinse in clear water, and plunge in a filtered solution of tannic acid, 2 parts; distilled water, 100 parts. Keep in this solution about twelve hours. If not as dark as desired, intensify by adding to the bath a few drops of ammonia water. Take out after a few minutes and wash thoroughly. The prints resemble sepia drawings. A greenish tone may be given blue prints by immersing after washing in a 1 per cent solution of sulphuric acid.

(6960) W. C. W. says: Will you please give me receipt for a good wine of coca? A. This is a French preparation. Its strength is about 1 in 30, and the dose a wineglassful. Coca wine is, roughly speaking, about one-sixth of the strength of the official liquid extract (Extractum Cocæ Liquidum B. P., or Extractum Erythroxyli Fludium U. S.) To obtain the liquid extract, coca leaves are exhausted by percolation (which differs from either decoction or infusion) with proof spirit. At the termination of the process the strength should be adjusted so that 1 ounce = 1 of leaves. The process of percolation is as follows: The leaves are placed in a vessel very like an elongated funnel, closed at its base by a porous diaphragm. This funnel fits into a receiver, and a small tube passes up its outer side and enters it near the top, forming a means of communication between the two. Spirit is now poured on the leaves, and the percolator closed. As the percolate filters slowly through into the reservoir, the displaced air passes up the tube, and so maintains an equilibrium in both vessels. The virtue of the coca leaves lies principally in the presence of the alkaloid cocaine. This, in the dried leaves, is supposed to exist as an inert salt, similar to many of the cinchona alkaloids in bark.

(6961) M. H. R. says: I have a 12 inch reflecting telescope, 72 inch focus. What diameter and strength of concave lens is required to make an amplifier, or "Barlow" lens to be used with the telescope, to enable me to take photographs of the moon? And will it make any difference as to which side of the lens is put next to the eyepiece? A. It will depend on the mount or tube of the telescope as to where the amplifier can be placed. The nearer the focus the smaller diameter it can be. As to focus, it will depend on how much amplification is wanted. The general size of a Barlow lens is 1 inch diameter and 6 inches focus. If it is correctly made for photographing, it will not make any difference which side is in.

(6962) H. S. writes: Some weeks ago there was published in your weekly an exhaustive article on the heat-resisting powers of different materials suitable for steam boilers and pipe coverings. I am in a dispute as to the merits of hair or asbestos covering. So I want to right myself before deciding. A. We give the relative values of different materials. We give following tests of Mr. G. B. Dumford, of Hamilton, Ont.

	Per cent.
Combination of asbestos, hair felt, air space and wood	100
Asbestos and hair felt and chopped straw, the straw mixed with lime putty	87
A plastic cement manufactured by parties at Troy, N. Y., with ½ inch half felt outside.	86·6
Paper pulp mixed with lime putty, 1 inch, covered with sheeting of wood pulp.	85
Mineral wool cased with wood	81
" " cased with sheet iron	79
Charcoal	60
Sawdust	41
Loam and chopped straw sealed with wood	32
Asbestos	29
Coal ashes	24
Air space	20
Fire brick	15
Red brick	12
Sand	9·3

(6963) F. F. says: Please be so kind as to inform me how to polish cattle horns. A. First scrape with glass to take off any roughness, then grind some pumice stone to powder, and with a piece of cloth wetted and dipped in the powder, rub them until a smooth face is obtained. Next polish with rottenstone and linseed oil, and finish with dry flour and a piece of clean linen rag. The more rubbing with the stone and oil, the better the polish. Trent sand is used in the Sheffield factories. It is a very fine and sharp sand, and is prepared for use by calcining and sifting.

TO INVENTORS.

An experience of nearly fifty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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September 8, 1896,

AND EACH BEARING THAT DATE.

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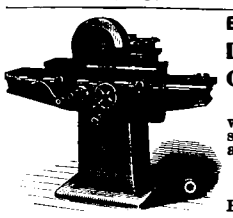

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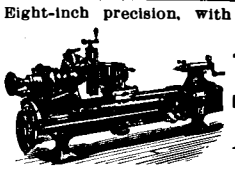

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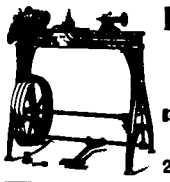

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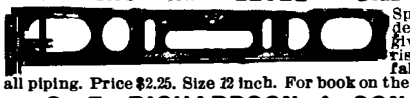

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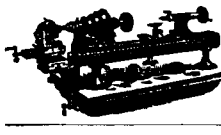

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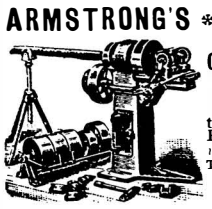

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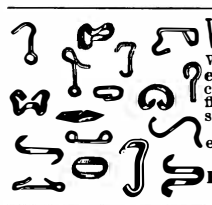

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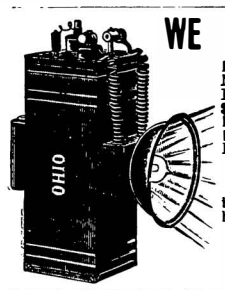

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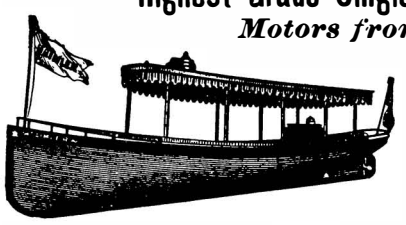

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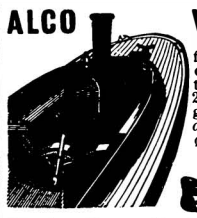

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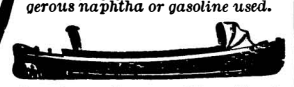

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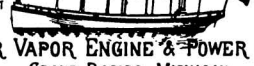

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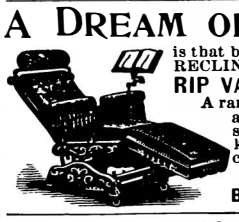

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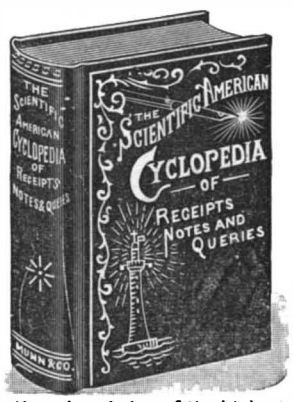

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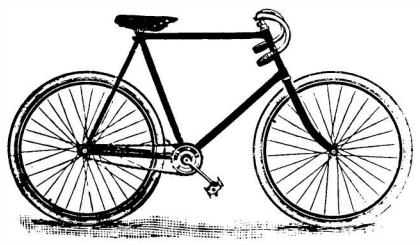

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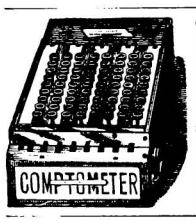

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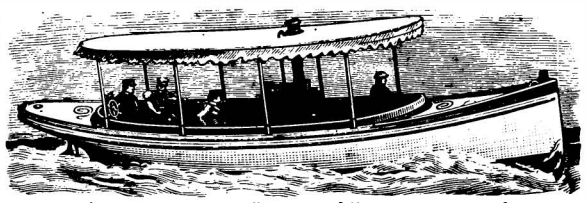

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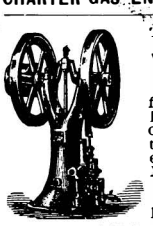

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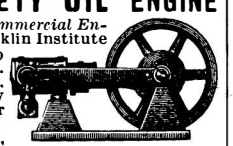

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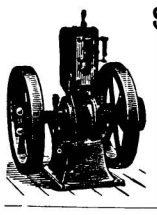

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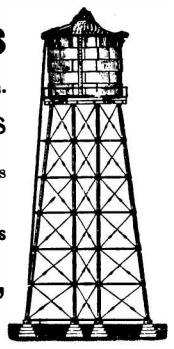

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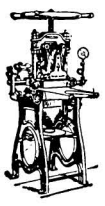

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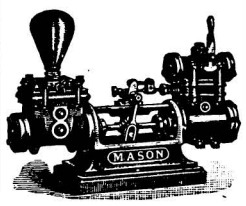

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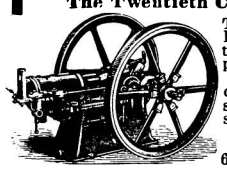

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